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F01 Workbook - Module 4

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Workbook - Module 4

Model: F01/F02

Production: From Start of Production

OBJECTIVES

After completion of this module you will be able to:

- Understand the new driver assistance systems implemented into the F01/F02.
- Describe the function of the different driver assistance systems in the F01/F02.
- Identify the components of the different driver assistance systems.
- Describe the changes to the ACSM 3 system compared to the E65/66 Passive Safety system.
- Describe what the Ethernet connection is utilized for on the F01/F02.
- Understand Sweeping Technologies.
- Understand the ISTA (Integrated Service Technical Application) and ISTA-P Programming tools.

HUD

The head-up display in the new BMW 7 Series incorporates various functions aimed at enhancing road safety and driver convenience.

That includes display of:

- Information from the DCC cruise control system
- Information from the navigation system
- Check Control messages
- Road speed.

Having the displays in the driver's direct field of view increases safety, as the eyes are always on the traffic.

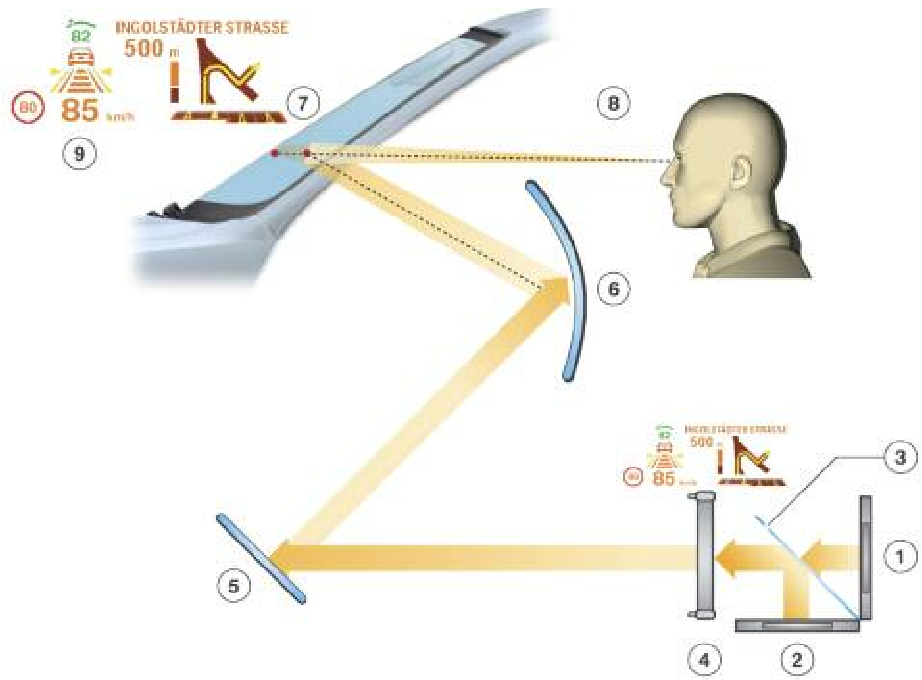
The HUD can be compared to a projection device. A light source is required to project the HUD information. The LED array acts as this light source. The image content is created by the TFT projection display. The TFT projection display can be compared to a filter which admits or blocks light.

An optical imaging element determines the shape and size of the HUD images.

The image is projected onto the windshield and appears freely suspended over the road surface.

Note: The HUD system used in the F01/F02 has been based on the previous head-up display system. Both systems share many components and operating principals.

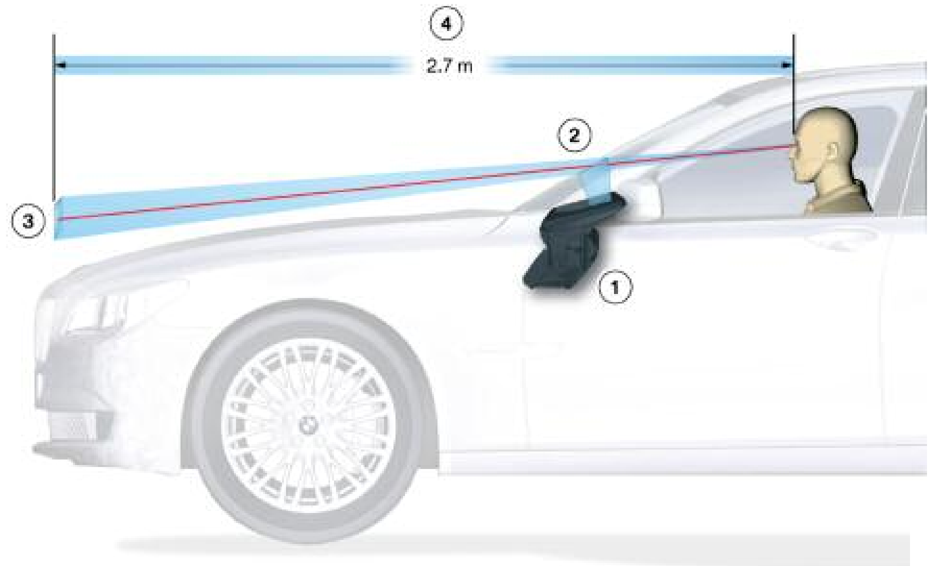
Principle of the head-up display



Index	Explanation	Index	Explanation
1	LED array, green	6	Curved mirror
2	LED array, red	7	Windshield
3	Transparent mirror	8	Observer's point of vision
4	TFT projection display	9	Projected image
5	Plane mirror		

Projection Distance

The projected HUD image content appears at a distance of approximately 2.7 m from the observer's eye.



Projection distance

Index	Explanation	Index	Explanation
1	Head-up display	3	Projected Image
2	Windshield	4	Projected distance

Controls

The following controls are used in the operation of the HUD:

- ON/OFF button on the BEFAS
- Dimmer wheel in the light switch cluster
- Controller.

Switch-on

The HUD receives the terminal 30 ON status via the K-CAN. The HUD is partially ready for operation from terminal R ON. That means that:

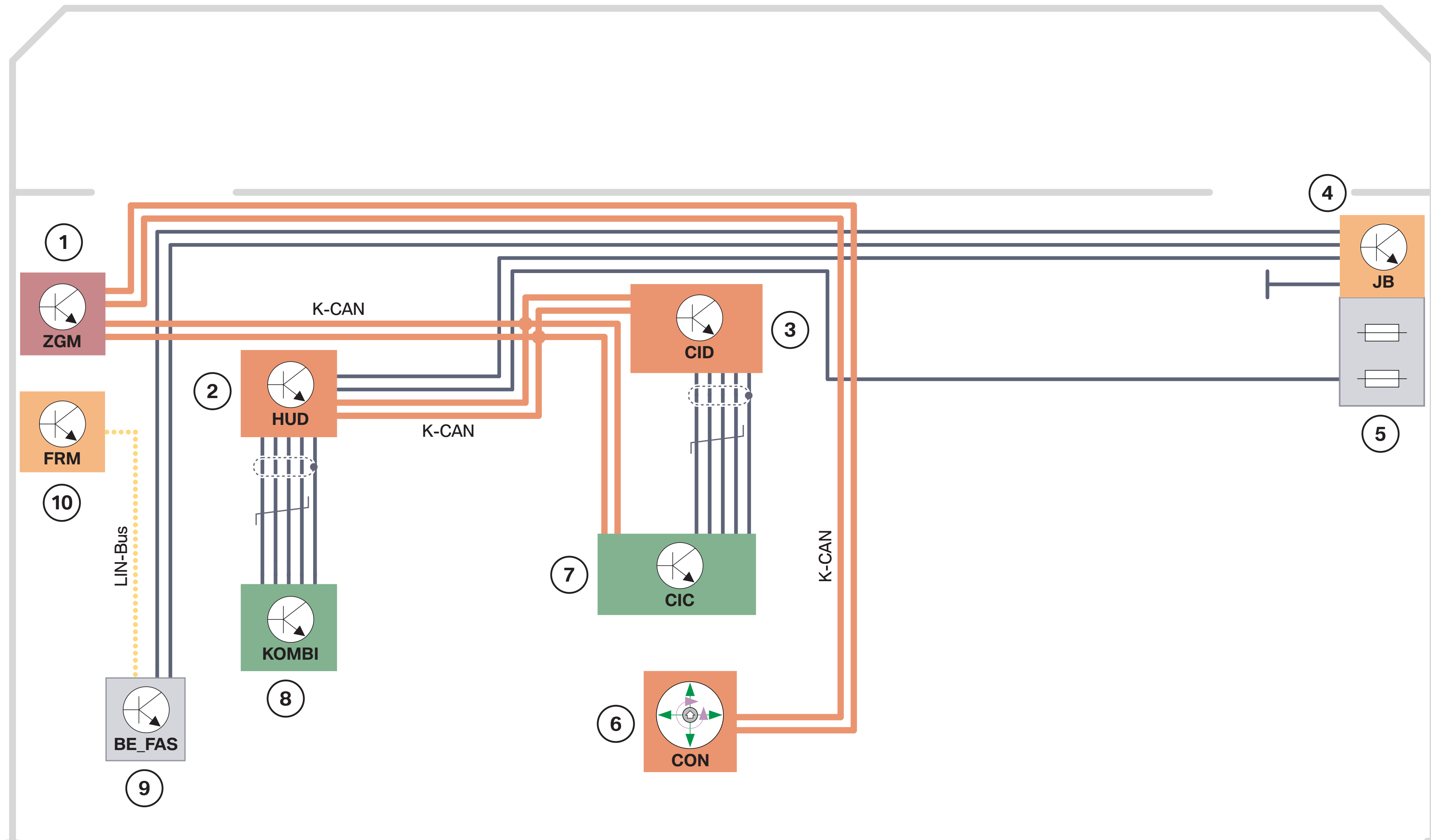
- The HUD can communicate with the other electrical-system devices via the K-CAN
- The TFT projection display is initialized and blanked
- The LEDs are off.

The HUD receives the terminal 15 ON status via the K-CAN. The HUD is ready for operation from terminal 15 ON. This permits the following actions:

- Switching on of the backlighting by the button on the BEFAS
- HUD height adjustment
- Adjustment of HUD brightness
- Display of information via the HUD.

When the vehicle is started, the vehicle is set to terminal 50 status. In terminal 50, i.e. Lights Off, the HUD goes into a hold status. This hold status is maintained until shortly after the end of the terminal 50 status.

Head-up Display System Schematic Circuit Diagram



Index	Explanation	Index	Explanation
1	Central Gateway Module, ZGM	7	Car Information Computer, CIC
2	Head-up display HUD	8	Instrument cluster KOMBI
3	Central Information Display CID	9	Driver assistance system control panel (BEFAS)
4	Junction box, JB	10	Footwell module FRM
5	Front power distribution box	K-CAN	Body controller area network
6	Controller	LIN-Bus	Local Interconnect Network bus

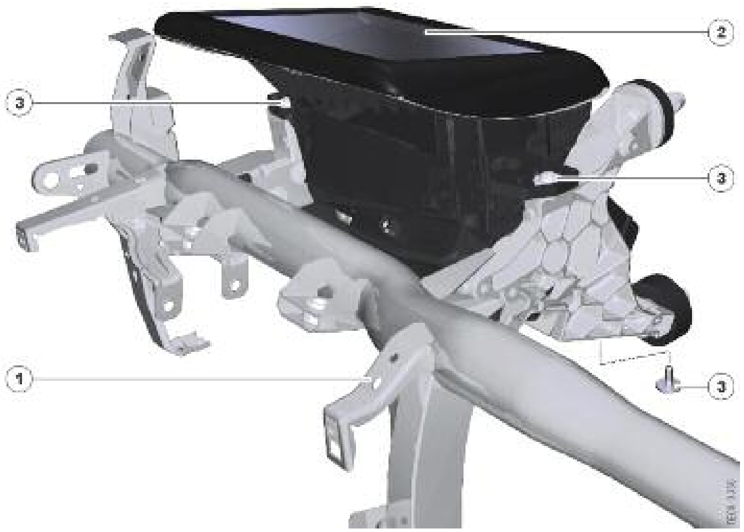
K-CAN signals to HUD control unit

In/out	Information	Source/sink	Function
In	Road speed	Instrument cluster	Display in the HUD
In	Check control message	Instrument cluster	Display in the HUD
In	Dimming/ brightness	Rain and driving light sensor (RLS) via roof function Center (FZD)	Brightness adjustment
In	Height adjustment	CIC	Height adjustment
In	Brightness offset	CIC	Brightness adjustment
In	DCC	EHB3	Display in the HUD
In	Function selection	CIC	What is displayed in the HUD
In	On/Off switch	BEFAS	Switching the HUD On/Off
In	Navigation	CIC	Display in the HUD

System Components

The head-up display is fitted above the steering column, immediately behind the instrument cluster. It is fastened to the bulkhead supporting structure by three hexagon-head bolts.

Location of head-up display (HUD) in F01/F02



Index	Explanation	Index	Explanation
1	Carrier bracket	3	Hexagon bolt
2	Head-up display HUD		

The head-up display comprizes the following components:

- Cover glass
- Mirrors
- 2 LED arrays
- TFT projection display
- PCB
- Housing.

The following components are required in addition to the components listed above:

- Windshield
- Light module and BEFAS
- Rain/light sensor
- Roof function Center and junction box
- HUD trim.

The following elements are needed to operate the HUD:

- On/Off button on BEFAS
- Light switch in the light switch cluster
- Instrument-lighting dimmer and
- Controller.

Cover Glass

The cover glass is made from scratch-resistant, coated polycarbonate (PC) and forms the top cover of the HUD. The cover glass protects the interior of the HUD against dust and objects accidentally placed on it.

The glass combined with the HUD trim are curved so that any incident light is not reflected back to the driver.

It also guarantees unobstructed projection of the display information onto the windshield without interference from stray light effects, for instance.

Glass Cover

Mirrors

Two mirrors are fitted in the head-up display. They reflect the information in the display onto the windshield.

The concave mirror (1) is responsible for compensating for the curvature of the windshield and for the size and distance of the image.

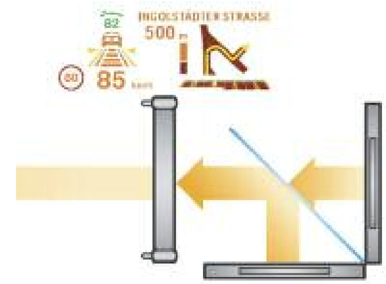
The flat mirror (2) is a deflecting mirror to keep the beam in the space provided.

The convex mirror is made of plastic while the flat mirror is made of glass.

Mirrors

LED Array

There are two LED arrays. The LED array is an arrangement of LEDs in one plane and acts as the back lighting for the TFT projection display. The LED array generates the light required for the HUD brightness. The LED arrays consist of red and green LEDs. The LEDs generate the brightness of the HUD content as controlled by the master PCB.



LED Array

PCB

The following components among others are incorporated on the PCB:

- K-CAN interface
- Processor (CPU)
- LVDS controller
- EEPROM memory
- Power supply.

The video signals are passed on to the display by the instrument cluster via an LVDS lead.

PCB

Eyebox

The eyebox is the movement space in which the driver can move without his view of the image in the HUD being impaired.

The freedom of movement within the eyebox is roughly:

- 70 mm vertically plus ± 30 mm range of adjustment
- 130 mm horizontally.

The HUD image is not clearly visible outside the eyebox limits.

Driver Assistance System Control Panel

The HUD On/Off button is located on the BEFAS. The button is resistance-coded and routed directly to the HUD. The HUD can identify the button signals or a button fault using the resistance coding.

ON/OFF button on the BEFAS

Instrument-lighting Dimming

The dimmer setting is also used for the HUD with active head-lights. The dimmer signal is emitted by the light module.

Instrument-lighting dimming

Controller

The HUD brightness and height settings are adjusted with the Controller via the CID. Brightness setting is also termed brightness offset. Functions such as e.g. navigation can also be set with the Controller in the Function selection menu. Therefore these settings have an indirect effect on the HUD display.

Adjusting the Brightness

The brightness of the HUD can be individually adjusted through the controller and iDrive in the “Settings” menu.
The brightness is set as follows:

- Call up the main menu by pressing the menu button
- Press the Controller and select the menu option “Settings”
- Turn the Controller until “Head-up display” is selected on the menu bar and then press the Controller to confirm selection
- Turn the Controller until “Brightness” is selected and then confirm
- Set the desired brightness by turning the Controller and con-firm by pressing.

Adjusting the brightness

Adjusting the Height of the Horizon on the HUD

On the BMW 7 Series F01/F02, the driver can adjust the location of the image and the eyebox to suit his/her particular requirements using the iDrive controller.

The eyebox can be shifted up to a maximum of ± 30 mm upwards or downwards.

The height setting is adjusted as follows:

- Call up the main menu by pressing the menu button
- Press the Controller and select the menu option "Settings"
- Turn the Controller until "Head-up display" is selected and then press the Controller to confirm selection
- Turn the Controller until "Height setting" is selected and then press to confirm
- Set the desired height by turning the Controller and confirm by pressing

Adjusting the Height

Note: The height can only be adjusted when the HUD is active.

The height adjustment is in the scope of the PIA. The setting is stored in the EEPROM for each key. If the signal "Radio remote key status" is received when Terminal 30 is on, the mirror moves to the position set for the current key.

The mirror remains in that position as long as the HUD is switched on.

Vertical Rotation of the HUD

The HUD is supplied as standard with a defined basic setting. The HUD image can be rotated in the horizontal by a service technician using vertical rotation, after a change of windshield, for instance.

The display is adjustable within a range of -° to +3° by means of a motor.

Detailed information may be found in the TIS and ISIS.

Test Functions

Calling/quitting Test Functions

Certain test functions may be also invoked directly on the HUD without using a BMW diagnostic system, as follows:

- Press and hold the button on the BEFAS for approximately 20 seconds and then release.
- Call up further test functions by pressing the button again
- To exit this function, press and hold the button on the BEFAS for more than 20 seconds.

Classroom Exercise - Head Up Display

1. What information can be displayed in the HUD?

2. Which display settings can be changed via iDrive?

3. Which display settings can be changed via the BMW Diagnosis System?

4. How are the adjustments carried out by the HUD unit?

5. How much freedom of movement does the driver have with in the eyebox.

Night Vision 2

The BMW Night Vision 2 system provides the driver with a black-and-white image of the driving environment ahead of the vehicle in the control display CD or central information display CID.

BMW Night Vision 2 is a passive system. Objects situated ahead of the vehicle are shown in varying degrees of brightness depending on the temperature of these objects. This enables the driver to detect in good time heat-emitting objects such as, for example, persons, animals and other vehicles.

This thermal image is recorded with a Far Infrared camera (FIR) via a special imaging sensor which detects the infrared radiation in a specific wavelength range.

In comparison with the previous system, Night Vision 2 employs algorithms in the control unit that makes it possible to automatically detect people in the image. Following an evaluation of distance and direction of movement, a symbol on the central information display CID and in the head-up display HUD warns the driver of any persons at risk.

The BMW system is distinguished from infrared systems by its robust resistance to dazzling, its long range and its clearly structured image.

The system offers the customer the following advantages:

- Highlighting of non-illuminated, heat emitting objects such as pedestrians, cyclists, vehicles and animals
- Better overview of the driving situation thanks to the depiction of the route of the road beyond the headlight cone
- Improved vision in twilight (dawn/dusk) and darkness
- Symbol warning of persons at risk in the area ahead of the vehicle
- No dazzle in the screen image caused by the headlights of oncoming vehicles
- Display of dark courtyard and garage entrances.

Night Vision 2 is designed as a supporting system, which, with a modified driving style, affords the driver a better overview of the road conditions ahead of the vehicle.

Note: The driving speed must be adapted to the relevant visibility conditions.

Principle of Pedestrian Detection

The Night Vision 2 control unit is equipped with three processors containing software, which, in addition to image processing for display, execute an automatic person detection function. The software searches the image for objects with human shape and classifies these objects as persons.

Their position, speed and distance to the vehicle are then determined. The risk level is analysed based on these parameters as well as on the speed and yaw rate of the vehicle and a warning is triggered.

The warning for the driver, indicating persons at risk, is given in the form a corresponding symbol in the central information display CID or head-up display HUD.

These ranges change with increasing vehicle speed and follow the direction of the vehicle as a function of the current steering angle (yaw rate).

Symbols in CID

In order not to unnecessarily distract the driver not all persons identified in the image are signalled by a symbol. Only persons who are in a certain area directly in front of the vehicle are indicated by a symbol.

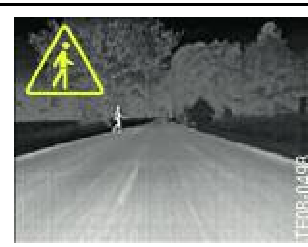
The system also warns of pedestrians located in an extended area to the left and right of the vehicle and are moving towards the central area (threat of collision).

People who are within the central zone are always indicated. Persons in the extended area are only indicated if they are moving in the direction of the central area.

Under optimum conditions, the automatic pedestrian detection function operates at a distance of up to 100m/109yd. At a driving speed in excess of 100 km/h/62 mph, the time between signalling and passing the person and therefore the reaction time for braking and evasive maneuvers is reduced.

Various Forms of Indication

The following table shows the different forms of indication in the two display instruments CID and HUD.

Situation	Indication in CID	Indication in HUD
No pedestrians in the danger zone.		
There is a person at a great distance from the vehicle.		
There is a person at a closer distance from the vehicle.		
A person is crossing the road from right to left.		
A person is crossing the road from left to right.		

Availability Indicator in CID

The availability of the Night Vision 2 system can be restricted by environmental conditions such as heavy rain, extreme +/- temperatures or fluctuations in light conditions.

Availability indicator in CID

The possible situations for the availability indicator in the CID are listed in the following table.

Situation	Symbol	Display
The driver has activated the person detection function and the system is available		
The driver has activated the person detection function but the system is not available, the Night Vision 2 image is still shown		
The driver has deactivated the person detection function, the Night Vision 2 image is still shown		

Symbols in HUD (Head-up Display)

If a person is detected at a great distance inside the warning range of the system the pedestrian figure will be shown distinctly above the road symbol. This is refered to as long-distance warning.

Long-distance warning

If a person is detected in close range, inside the warning zone of the system, the pedestrian figure will be shown distinctly on the road symbol. This is refered to as short distance warning.

Short-distance warning

Warning in Vehicles without HUD

The warning symbol is shown on the CID in vehicles without HUD or with HUD deactivated. In addition, the CID initially flashes yellow 3 times when the warning comes on in order to catch the driver's attention.

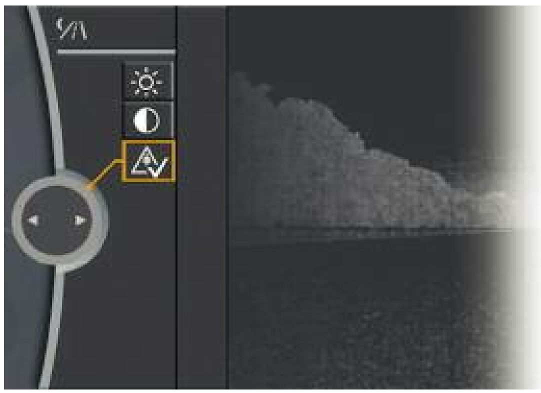
The warning is shown as soon as a person enters the warning zone directly ahead of the vehicle or a person crosses the road from the left or from the right.

Operation by iDrive

The individual functions and settings can be selected and activated through the iDrive.

The following settings can be selected on the F01/F02:

- Brightness
- Contrast
- Pedestrian detection.



Visibility

The illumination range in front of the vehicle with low beam is less than 50m/54yd.

Normal driving light illumination by fitted halogen headlights is 100m/109yd.

The high beam illumination range provided by xenon headlights is 150m/164yd. However, people can only be detected in this range if they are wearing reflective clothing.

Night Vision 2 will detect heat-emitting objects in the image up to a distance of about 300m/328yd, regardless of the amount of reflection their clothing gives off.

Automatic pedestrian detection has a maximum range of 100m/109yd. This specified distance is dependent on weather factors.

The range of vision is also reduced in the Night Vision 2 image in the case of thick fog or heavy rain. Night Vision 2 is designed as a supporting system, which provides the driver a better overview of the road conditions ahead of the vehicle.

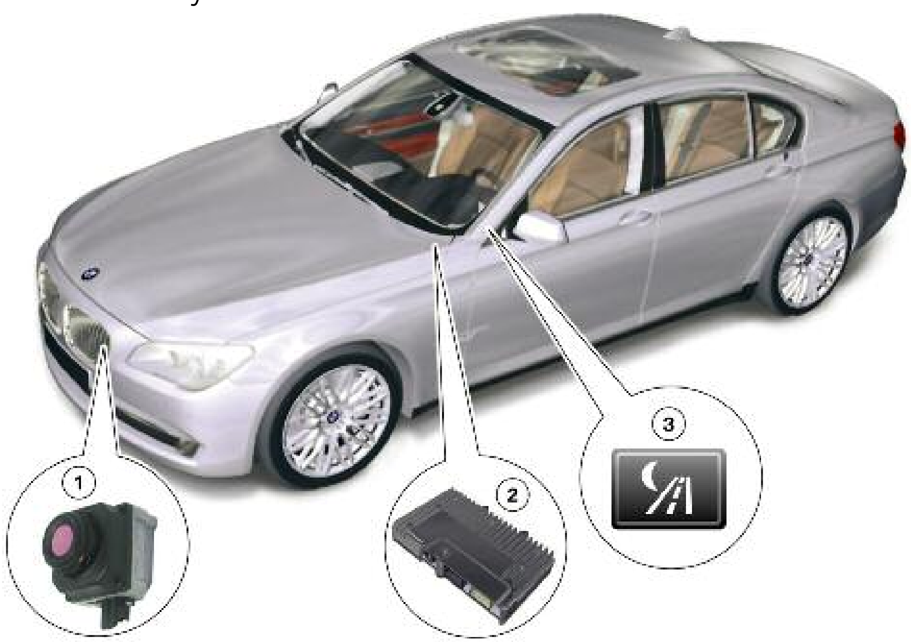
Night Vision 2 range of vision with different headlights

System Components

The BMW Night Vision 2 system consists of the camera, control unit, camera washer jet, button and the sensor system.

The BMW Night Vision 2 system consists of the following components:

- Night Vision 2 camera
- Camera washer jet
- Night Vision 2 control unit
- Button in BEFAS
- Sensor system



Index	Explanation
1	Night Vision 2 camera
2	Night Vision 2 control unit
3	Button in control panel of driver assist systems (BEFAS)

Night Vision 2 Camera

The Night Vision 2 camera is mounted with a bracket directly behind the left kidney grille. The camera is equipped with a sensor which detects heat-emitting objects in the far infrared range (wavelengths from 8 µm to 14 µm).

The infrared image camera consists of:

- a heated optical element
- an infrared image sensor.

BMW Night Vision 2 camera

The camera features:

- Resolution of 324 x 256 pixels
- Maximum angle of view 24°
- Ambient temperature range is -40°C/-40F to +80°C/176°F
- The image can be replaced up to 30 times per second.
- The camera to be calibrated approximately every 120 to 180 seconds to ensure consistent image quality. This calibration can take up to 0.3 seconds. The image may freeze briefly in the display while calibration takes place.

The washer jet is screwed to the camera bracket and is situated directly below the protective window. It is directly connected to the headlight washer system.

A heater element is incorporated on the inside of the protective window to prevent it from misting over or freezing up.

The heater is located at the edge of the protective window outside the camera's field of vision.

Night Vision 2 Control Unit

The control unit is installed behind the compartment in the area of the A-pillar directly under the light switch cluster.

BMW Night Vision 2 control unit

The Night Vision control is used:

- to increase the raw pixels from 324 x 256 pixels (camera) to 720 x 480 pixels
- to transmit the diagnostics, programming and coding data to the camera
- to supply power to the camera and the heated optical element
- to convert the image data from the camera into a dCVBS signal

Automatic pedestrian detection is executed in the control unit.

The diagnosis, programming and coding data are also transmitted to the camera through the control unit.

The camera and the protective window heater are powered via the control unit.

The raw image data from the camera are transmitted through a LVDS cable to the control unit.

The image output by the control unit is made available in the head unit in the form of a dCVBS signal.

The camera-housing cover features a 6-pin plug connection.

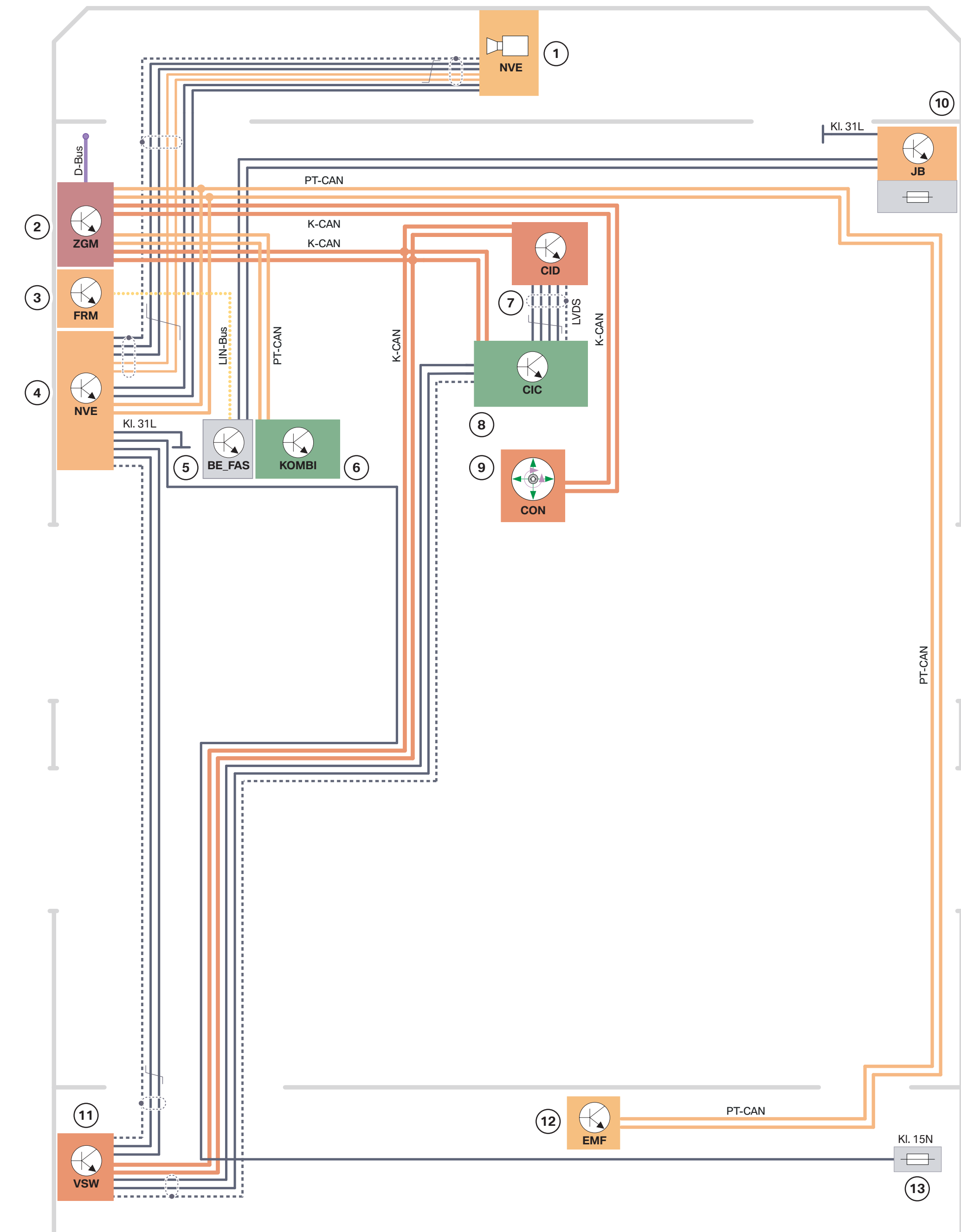
6-pin plug connection

The button for switching BMW Night Vision 2 on and off is integrated in the BEFAS.

Button in the BEFAS BMW 7 Series

Note: The pedestrian detection function is deactivated at speeds below 10 km/h/6mph. For more information regarding this feature refer to the Vehicle Owner's Manual.

System circuit diagram F01/F02



Index	Explanation	Index	Explanation
1	Night Vision 2 camera	11	Video switch (VSW)
2	Central gateway module (ZGM)	12	Electromagnetic parking brake (EMF)
3	Footwell module (FRM)	13	Power distribution box, rear right
4	Night Vision 2 control unit (NVE)	PT-CAN	Powertrain controller area network
5	Control panel, driver assist systems (BEFAS)	K-CAN	Body controller area network
6	Instrument cluster (KOMBI)	LIN-Bus	Local Interconnect Network bus
7	Central information display (CID)	D-Bus	Diagnosis bus
8	Car Information Computer (CIC)	Kl.31L	Terminal 31, ground
9	Controller (CON)	Kl.15N	Terminal 15, after running (voltage)
10	Junction box electronics (JB)		

Connection of Control Units and Camera

The Night Vision 2 control unit and the night vision camera are connected through the following cables:

- Private CAN-bus; Diagnosis, programming and camera control
- LVDS-Video; Video signal from the camera
- CAM_POW; Power supply from control unit to camera, heating of camera lens
- Ground; Common ground of camera and control unit for suppressing interference.

The video signal is sent via a shielded LVDS cable between the camera and control unit. In the control unit the signal is converted into an dCVBS (d = differential) video signal and, depending on the equipment specification, transmitted to the CIC or the video switch.

The camera is powered under the following conditions:

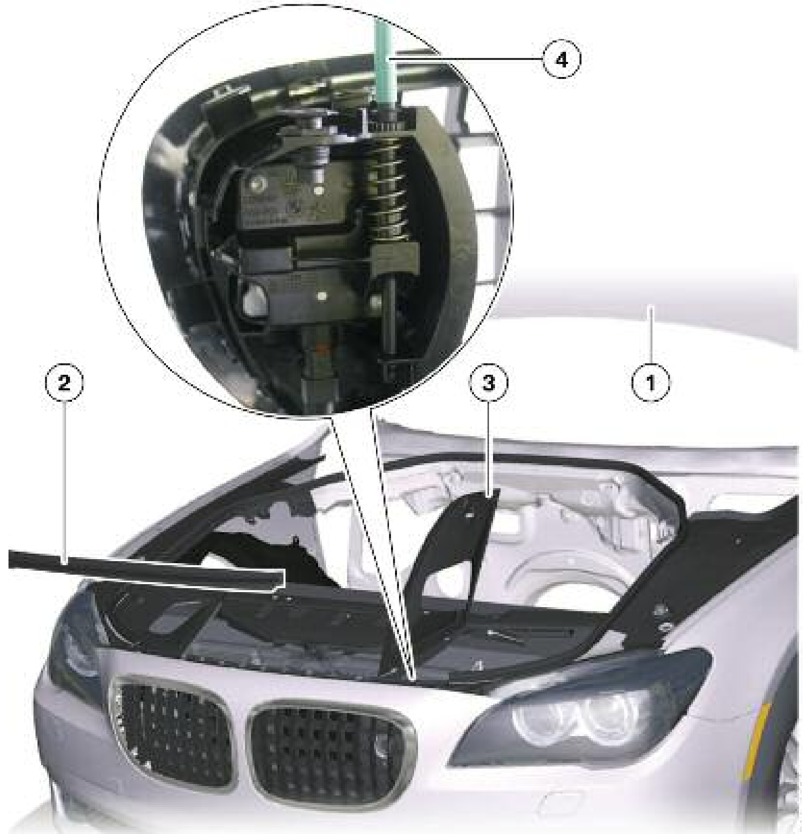
- BMW Night Vision 2 switched on by pressing button in control panel of driver assist systems (BEFAS)
- Rain-driving lights sensor detects twilight or darkness.

The BMW Night Vision 2 control unit is powered by the rear distribution box via terminal 15N.

PT-CAN

The PT-CAN connection of the Night Vision 2 control unit serves to transmit the diagnosis and programming data and to read out the information from the RLS (brightness), the JB (driving lights status, wiper speed) and ICM (road speed and yaw rate). In addition, the terminal status and the vehicle identification number (VIN) are transferred to the control unit via the PT-CAN.

Adjusting Camera Pivot Position



Camera alignment

The pivot position of the camera can be adjusted by means of an adjusting screw at the bracket.

The following steps must be taken to adjust the camera on the F01/F02:

- Open hood(1)
- Remove sealing lip (2) on front panel
- Open headlight cover (3)
- Position headlight adjustment unit with spirit level in front of vehicle
- Insert Allen key (4) through the opening in the front panel and set the camera to the required position; the line in the image must be parallel to the spirit level
- Reassemble all parts that have been removed in reverse order.

Replacing Protective Window

In the event of damage the camera protective window can be replaced.

Replacing front lens

Replacing Camera Washer Jet

A washer jet with a direct connection to the headlight washer system for cleaning the protective window is mounted on the camera.

Camera washer jet

Follow The procedure below to replace the washer jet:

- Remove bumper panel
- Remove left-side kidney grille
- Undo two recessed cross head screws (1)
- Release the hose clip on the connecting hose to the headlight washer system and remove the washer jet towards the front
- Reinstall all parts that have been removed in reverse order.

Note: Camera alignment is only possible with a BMW diagnosis system. For detailed information on how to service the Night Vision 2 camera, lens or washer jet please refer to the Repair Instructions available in TIS or ISTA diagnostic equipment.

Displays Indicating Defective System

In the event of a system defect, the following warnings are shown in the F01/F02:

- Check Control message in the instrument cluster
- The same Check Control message in HUD if installed.

Display indicating defective system

Programming and Coding

Initializing Software

When replacing the camera, it is always necessary to initialize the software by entering an enable code (FSC).

Note: The vehicle identification number (VIN) must always be quoted when ordering a new camera or a new control unit.

The camera is programmed and diagnosed through the control unit. The control unit receives the programming data for the camera through PT-CAN and forwards this data to the camera through the "private CAN-bus".

Workshop Exercise - Night Vision 2

Using an instructor assigned F01/F02 vehicle, the ISTA diagnostic equipment, perform the following tasks.

Task 1: Perform the Night Vision 2 Camera Calibration.

Task 2: List the tools necessary to perform the camera calibration below.

Workshop Exercise - Night Vision 2 - Review Questions

1. What must be done after the Night Vision camera is adjusted to finalize the procedure?

2. What must be communicated to the customer after the Night Vision camera adjustment has been performed on the vehicle?

3. Which components of the Night Vision 2 camera are replaceable?

4. What bus signal pathway is used to program and diagnose the Night Vision 2 camera?

Classroom Exercise - Review Questions

1. Under what conditions does the Night Vision 2 control unit provide the power supply for the Night Vision 2 camera?

2. To which vehicle bus system is the Night Vision 2 control unit directly connected?

3. What is this connection used for?

4. What conditions affect the maximum visibility range of the BMW Night Vision 2 system?

5. How far does the maximum visibility range of the BMW Night Vision 2 system extend?

ACSM 3

A version of the ACSM system has been installed in many previous BMW vehicles, starting with the 5 Series as of 9/2005 to the E71 from 4/2008.

The E65/E66 air bag control units are interconnected via an ultrafast optical bus system, called the byteflight. On the F01/F02, the third generation of ACSM is used as the central airbag control unit for the passive safety system. It differs from the previous ACSM crash safety modules in that it has no internal sensors.

The function of the ACSM is to constantly evaluate all sensor signals in order to detect a collision situation. As a result of the sensor signals and their evaluation, the Crash Safety Module identifies the direction of the crash and the severity of the impact.

Also included is information on the occupants and whether they have their seat belts fastened or not. From this information, measures are taken to selectively trigger the necessary restraint systems.

The crash safety module monitors the system itself and indicates that the system is ready for operation when the airbag warning lamp (AWL) goes out.

If a crash situation is detected, this is communicated to the other users in the bus-system network by way of a bus signal. The relevant control units respond to this signal by executing their own activities according to the severity of the crash.

The activities include:

- Opening the central-locking system
- Activating the hazard warning flashers
- Switching on the interior lighting
- Deactivating the fuel pump
- Automatic emergency call.

A function of ACSM is the seat belt reminder function, which uses optical and acoustic signals to remind the driver and front passenger to fasten their seat belts.

The functions of the ACSM are divided into:

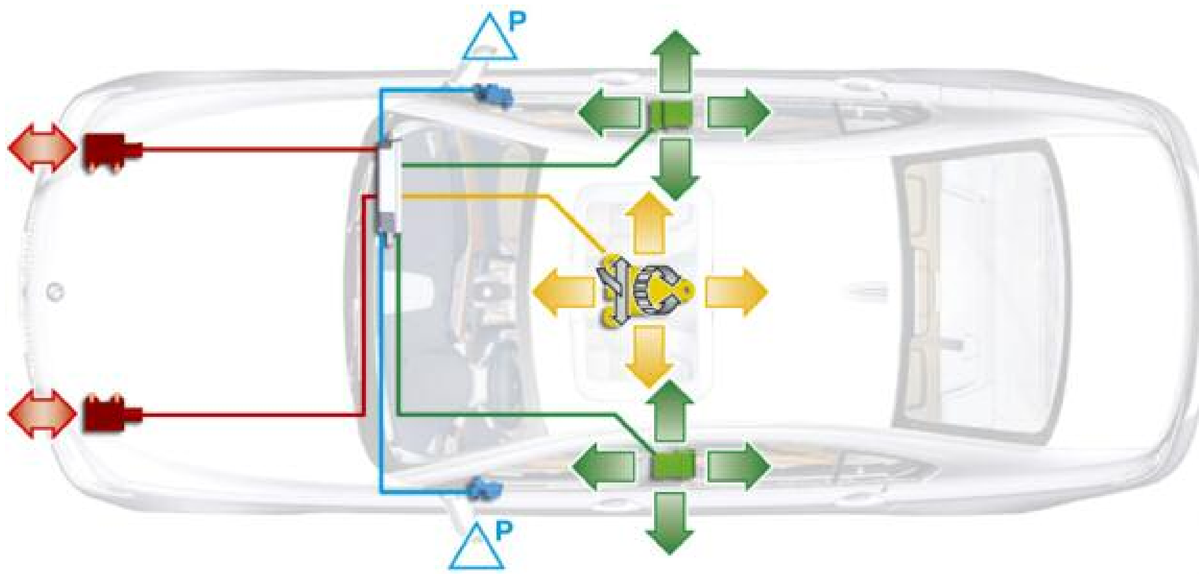
- Crash-relevant functions
- System monitoring functions
- Additional comfort functions.

Functions

The Crash Safety Module must fulfil the following crash-relevant functions:

- Evaluating the sensor signals
- Crash and rollover detection
- Determining the triggering times and order
- Triggering the output stages of the firing circuits
- Output of a crash telegram for other users in the bus system network
- Crash documentation
- Emergency call functions.

Evaluating the Sensor Signals



Crash and Rollover Detection

In addition to the longitudinal acceleration sensor and lateral acceleration sensor the central sensor also incorporates rollover detection. Rollover detection consists of a rate of yaw sensor and two low-g sensors. One low-g sensor measures in the Y direction, the second sensor in the Z direction.

Additional airbag sensors are mounted in the B-pillars. These each consist of a longitudinal acceleration sensor and a transverse acceleration sensor.

Together with the transverse acceleration sensor in the central sensor, the transverse acceleration sensors serve to detect side-on crashes. Pressure sensors are also used in the front doors to detect side-on crashes.

Together with the longitudinal-acceleration sensor in the central sensor, the longitudinal-acceleration sensors serve to detect front- and rear-end crashes.

There are two airbag up-front sensors for front-end crash detection. They are located on the front area of the engine side members.

Detecting a crash and determining the triggering times and the order

The Crash Safety Module uses the values transmitted by the sensors to determine the direction and severity of the crash. The threshold values of two independent sensors must be exceeded in order to detect a crash. In the case of a front-end crash, for example, the relevant high acceleration values from the B-pillar satellite and from the longitudinal acceleration sensor must be detected in the crash safety module. Triggering the output stages of the firing circuits

Based on the acceleration values and crash severity and direction, an algorithm determines the triggering (firing) points and the order of the restraint systems to be activated.

A possible imminent rollover is also detected and the appropriate protection systems are activated.

Triggering the output stages of the firing circuits

The firing-circuit output stages are only triggered if the airbag algorithm detects that the threshold has been exceeded via different sensors, e.g. the airbag sensor in the B-pillar and the central sensor.

The crash safety module is powered by the Car Access System4 CAS4 using terminal 30b. At terminal 30b the crash safety module is in energy-saving mode, which means it is active at the bus and can also transmit the belt status to the EMA controller. Airbag functionality is blocked and only ready for operation at terminal 15 on completion of the system self-test.

The firing capacitors, which also serve as an energy reserve, are charged up by a switching controller. These capacitors make the firing energy available in the event of a crash. If the voltage supply is interrupted during a crash, the firing capacitors serve briefly as an energy reserve.

The output stages of the firing circuits consist of a high-side and a low-side power circuit-breaker. The high-side power circuit-breaker controls the firing voltage, while the low-side power circuit-breaker switches to ground. The output stages of the firing circuits are controlled by the microprocessor.

The high-side and low-side power circuit-breakers also serve the purpose of checking the firing circuits during the system self-test.

Output of Crash Telegram

In the event of a collision involving triggering of the restraint systems, the Crash Safety Module sends a crash telegram to the users in the bus-system network. Parallel to this, the TCU is informed via a direct single-wire line to transmit an emergency call.

As a result, the respective control units perform the following functions depending on the crash severity:

Function	Control Unit
Switch off electric fuel pump	Digital Motor Electronics (DME)
Switch off the auxiliary heating	Integrated automatic heating and air conditioning system (IHKA) - Not for US
Release central locking	Junction box electronics (JBE)
Switch on hazard warning lights	Footwell module (FRM)
Switch on interior lights	Footwell module (FRM)
Transmit emergency call (only when airbag triggered)	Telematics Control Unit (TCU)

Crash Documentation Entries

In the event of a collision where one or more actuators are triggered, a crash entry is stored in a non-erasable memory. After three crash entries, a non-erasable fault entry is stored in the fault memory with the instruction to replace the crash safety module.

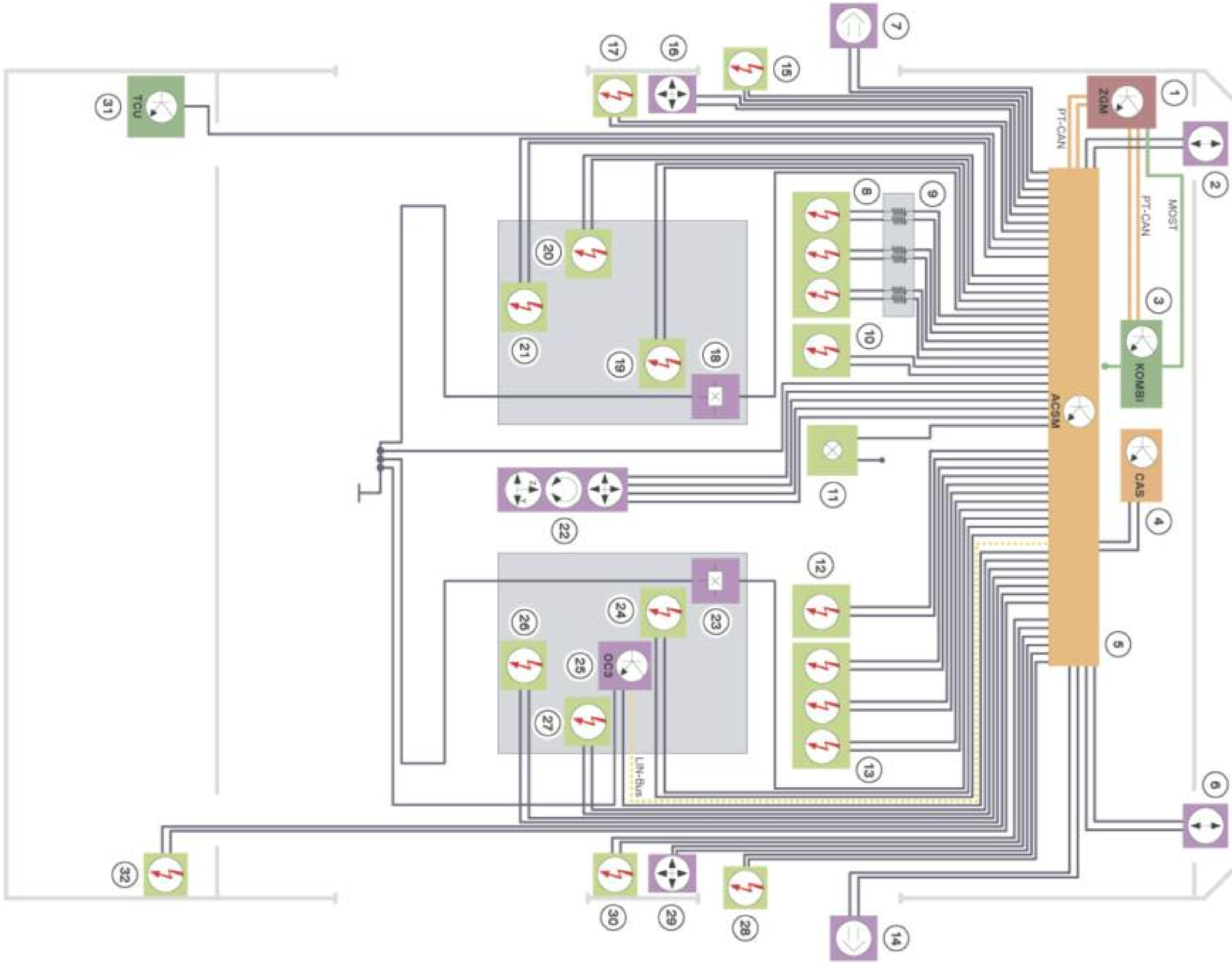
Note: The three crash entries could also be stored during the course of an accident. Each crash entry is assigned a system time.

The electronic control unit remains capable of firing even after three crash entries.

The crash entries cannot be erased and serve the purpose of subsequent device diagnosis.

A maximum of three crash entries can be stored. The control unit must then be replaced.

System Components



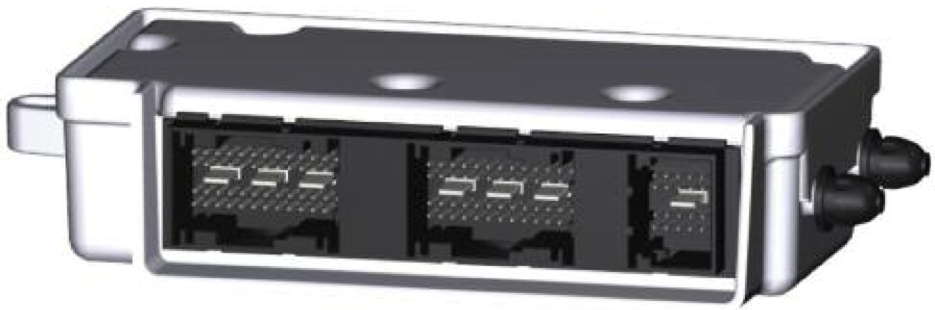
Index	Explanation
1	Central gateway module
2	Up-Front sensor, left
3	Instrument cluster
4	Car Access System
5	Crash safety module
6	Up-Front sensor, right
7	Door pressure sensor, left
8	Front airbag, driver
9	Coil spring for airbag
10	Knee airbag, driver
11	Passenger Airbag OFF light
12	Knee airbag, passenger
13	Front airbag, passenger
14	Door pressure sensor, right
15	Head airbag, left
16	B-pillar sensor, left
17	Adaptive belt force limiter, driver
18	Belt contact, driver
19	Seat belt pretensioner, driver
20	Side airbag, driver's side
21	Active head restraint, driver
22	Central sensor with rollover detection
23	Belt contact, passenger
24	Seat belt pretensioner, front passenger
25	OC3 mat
26	Active head restraint, passenger
27	Side airbag, passenger side
28	Head airbag, right
29	B-pillar sensor, right
30	Adaptive belt force limiter, passenger
31	Telematics Control Unit for emergency call
32	Safety battery terminal

Crash Safety Module

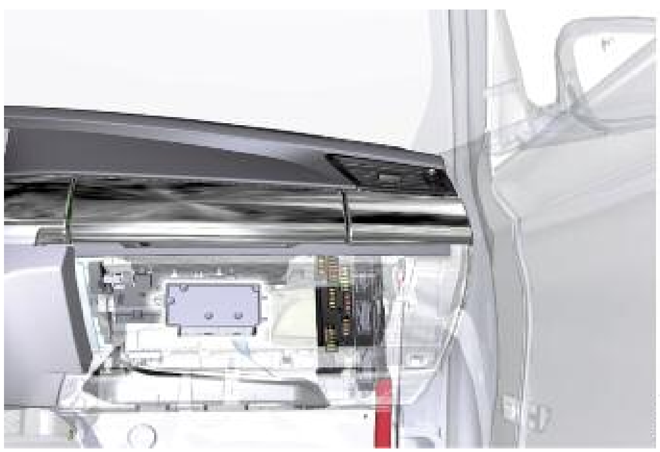
The crash safety module in US vehicles is identical to vehicles for the rest of the world and is adapted to the law and country-specific requirements by programming and coding.

There are no sensors located in the crash safety module.

With ACSM 3, the Crash Safety Module is now integrated into the PT-CAN.



The crash safety module has a new installation location for the F01/F02 is behind the glove compartment.



Sensors and Switches

All of the following sensors and switches were used on the previous ACSM systems with the exception of the Central Sensor, its functions where integrated inside the crash safety module.

- Central sensor
- Up-Front sensor
- OC3 mat
- B-pillar sensor
- Door pressure sensor
- Seat belt buckle switches
- Emergency call button

Central Sensor

The central sensor is located centrally in the vehicle on the transmission tunnel.

In addition to the longitudinal acceleration sensor and lateral acceleration sensor, the central sensor has also been extended to incorporate rollover detection.

The longitudinal and lateral acceleration sensors detect positive and negative vehicle acceleration in a measuring range of 0-100 g. The longitudinal and lateral acceleration sensors detect acceleration in the event of a head-on, side or rear-end collision.

Central sensor

Rollover Detection

Rollover detection is provided by a rate of yaw sensor and two additional low-g sensors. The low-g sensors act in Y and Z directions.

There are different factors which can cause a car to overturn or roll over. Although the most common causes are:

- The car hits a ramp (e.g. a crash barrier) on one side or the vehicle tilts due to the terrain. The car rotates about its longitudinal axis as a result of the high angular velocity.
- The car skids sideways off the road surface and its wheels become buried in soft soil. The kinetic energy could be sufficient to upend and overturn the car.
- The car skids sideways off the road into the curb and is upended.

The crucial factors which determine whether the car overturns are not just the angle of rotation but also the angular velocity or angular acceleration at which the car is set into the roll. All these vehicle movements can also occur after a front-end, side-on or rear-end crash.

The two Low-g sensors have a small measuring range of 0-2 g and can therefore detect small accelerations and decelerations with great accuracy.

For example, when the vehicle skids sideways off the road surface and buries itself with its wheels in soft ground.

The sensors provide a voltage as measured variable. This voltage is a measure for the acceleration and is converted directly into digital signals in the sensor. The digital values are sent to the crash safety module for evaluation. The crash safety module evaluates the signals from the two Low-g sensors and the rate of yaw sensor. The results are compared with the stored algorithm. If the processor detects that a rollover situation is imminent, the seat belt pretensioners and the head airbags are triggered.

The sensor cluster is connected via a four-wire lead. A current interface which transfers a special report is used for the five sensors, this saves on six leads. This interface is also used for the other airbag sensors, so that, here too, savings can be made on leads and thereby weight.

Digital data transmission by means of current interface

The recorded acceleration values of the micro-mechanical acceleration sensors are converted in an ASIC (Application Specific Integrated Circuit) into digital signals. With the aid of a data telegram, the digital signals are transmitted unidirectionally to the Crash Safety Module.

The signals are transmitted via a current interface, which supplies the electronic circuitry with voltage.

The electronic circuitry receives a voltage level of approximately 5-10 mA via the current interface. The level rises at a step of 20 mA when a data telegram is transmitted so that only two lines per measurement channel are required.

The transmitted data is evaluated in the crash safety module.

Actuators

The crash safety module is used in to control the following actuators:

- Adaptive driver airbag
- Adaptive front passenger airbag
- Driver/front-passenger side knee airbag
- Curtain/Head airbags, left and right
- Side airbag, integrated in the left and right front seats
- Front seat belt pre-tensioner, front left and right
- Automatic seat belt tensioner with adaptive force limiter
- Active head restraint, front left and right
- Safety battery terminal

The following warning lamps are additionally activated:

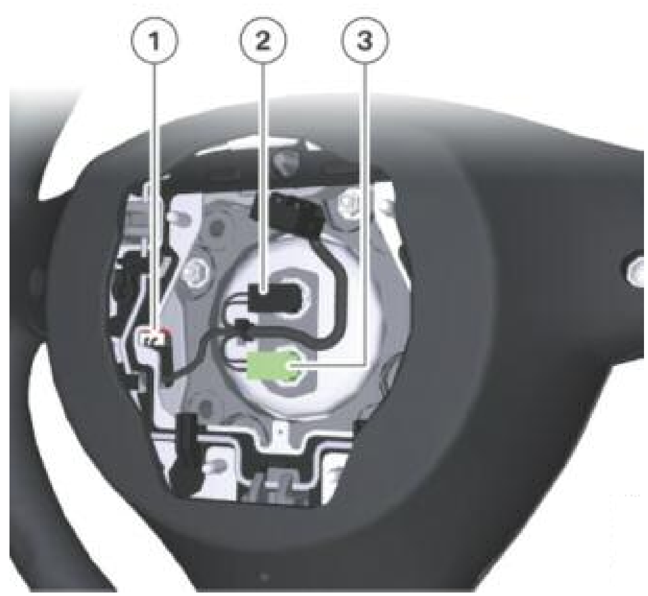
- Airbag warning lamp AWL
- Seat belt mannikin
- Passenger Airbag OFF light (POL)

Adaptive driver airbag with active vent valve

Index	Explanation
1	Gas generator with exhaust vents
2	Actuator for vent valve

Driver airbag without airbag

Index	Explanation
1	Connection of the squib for the active vent valve
2	Connection of the squib for the first stage
3	Connection of the squib for the second stage



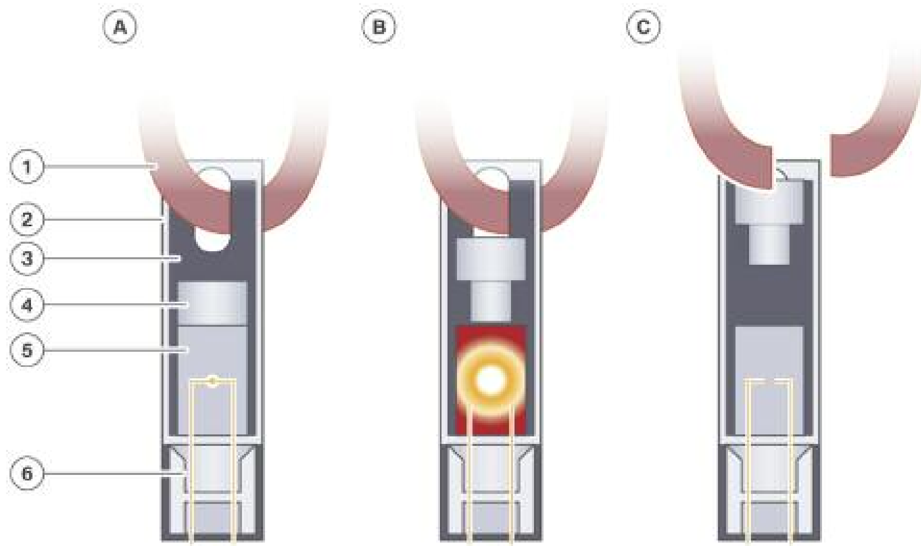
Driver airbag, rear, without retaining plate

Vent Valve

The F01/F02 uses airbags with pyrotechnically activated vent valves.

This measure serves to adapt the hardness of the airbag in possible accident scenarios with smaller people or persons sitting close to the steering wheel.

On the basis of the crash severity, belt status and seat position information, the crash safety module decides whether the vent valve is activated or not.



Index	Explanation	Index	Explanation
A	Vent valve is closed by arrester band	3	Cylinder
B	Squib triggered, blade is deployed	4	Piston with blade
C	Blade cuts through retaining strap and vent valve opens	5	Squib
1	Retaining strap	6	Squib connection
2	Housing		

The vent valve is an exhaust vent incorporated into the airbag, which is closed by an arrester band.

The arrester band ends in a cylinder, in which there is a blade. In the event of triggering, the blade is pushed in the cylinder by the pyrotechnical actuator and the arrester band is cut through.

Due to the airbag inner pressure, the exhaust vent opens outward and the airbag pressure is controlled by the venting gas.

The active vent valve is normally activated for smaller, lighter occupants.

If the system detects a heavy occupant, due to the seat position, a reduction of the airbag pressure is not desirable.

In this case, the active vent valve remains closed and is activated at a later stage for disposal firing, when the occupant is no longer in contact with the airbag.

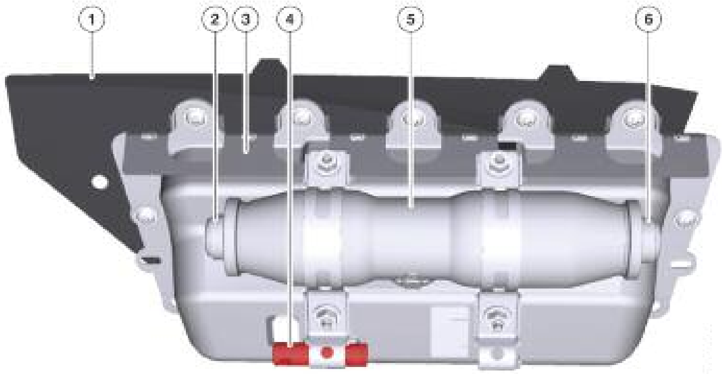
Vent valve remains closed

Heavy occupant

Vent valve is opened

Smaller, lighter occupant

Adaptive front passenger airbag with active vent valve



Front passenger airbag, two-stage with vent valve

Index	Explanation	Index	Explanation
1	Cover for airbag	4	Actuator for active vent valve
2	First stage squib	5	Inflator assembly
3	Airbag housing	6	Second stage squib

Knee Airbags

A knee airbag on the driver and front passenger side are standard equipment for the F01/F02.

In the event of a collision in which the driver or front passenger are not wearing seat belts, the knee airbag provides support to protect the knees. This initiates a controlled forward displacement of the upper body, which is cushioned by the deployment on the corresponding airbag.

Knee airbag in operation

The knee airbags are designed as a single-stage airbag with inflator assembly.

The airbag volume is approximately 20 liters/ 5.2 Gallons.

The gas generator is triggered in the event of a crash of sufficient severity and the resulting gas fills the airbag.

When the knees make contact with the airbag, the load is distributed over the area of the airbag, thus supporting the occupant.

The knee support results in a controlled forward displacement of the upper body that is taken up by the driver or passenger airbag.

The knee airbag on the driver's side is located below the steering column in the footwell trim while the knee airbag on the passenger side is located in the footwell trim.

F01/F02 driver's side knee airbag

Note: The driver and front passenger knee airbags are also triggered by occupants wearing seat belts, though at a higher crash severity than if the seat belts are not fastened.

Curtain/Head Airbag

On the F01/F02, the curtain airbag for the driver and front passenger side is used as head airbag.

The head airbag extends from the A-pillar to the C-pillar and covers the entire side section at the level of the side windows.

It deploys between the occupants, windows and pillar trim panels.

System features:

- Extended coverage for front and rear windows
- Reduction of the risk of glass splinters and objects entering the vehicle
- Optimized coverage even for different sizes of occupant.

The curtain airbag is housed folded up in the roof frame. It consists of the inflator assembly and the curtain.

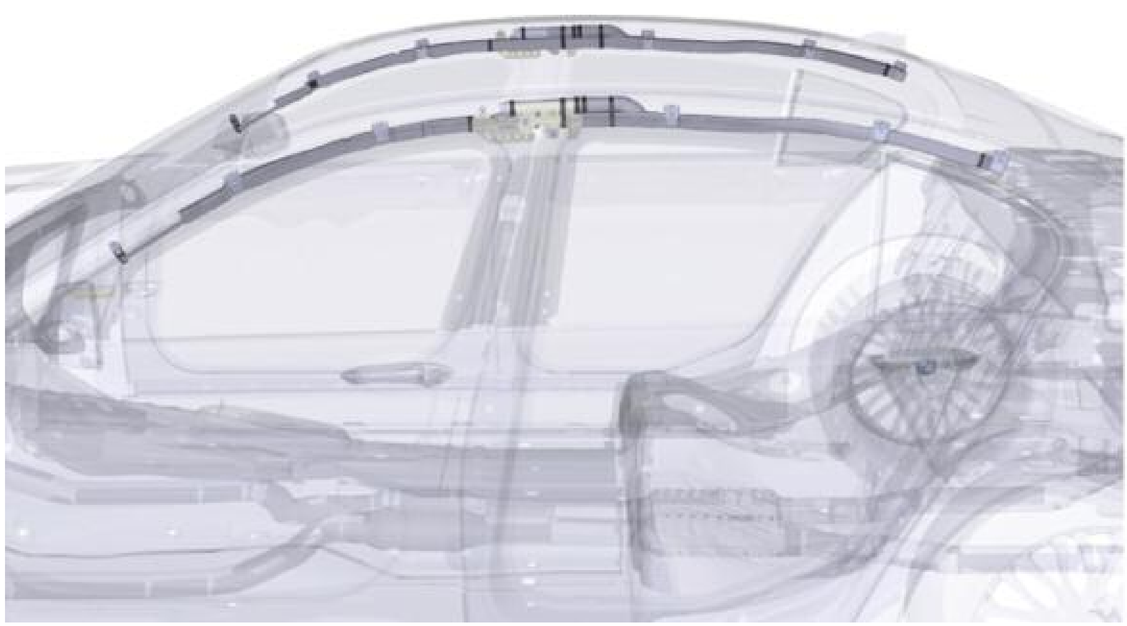
In the event of a side impact or rollover, the inflator assembly is triggered and a valve to the pressure tank is opened. The stored gas flows through the gas lance into the curtain.

The head airbag is set in the correct position by it's mounting on the A-pillar and on the C-pillar. In addition, the curtain deploys between the side windows, pillar trim panels and the occupants.

The structural strength and stability is preserved for several seconds by the closed system.

In connection with the side airbag in the front seat, it provides optimum protection for the occupants in the event of side impact.

The head airbag reduces the movement of the head and other occupant extremities towards the outside during a side impact. This results in lower neck shear forces as well as bending moments in the cervical vertebrae. It additionally prevents direct contact with the side structure or the obstacle thus reducing the risk of head injuries.



Installation location of the curtain/head airbags on the F01/F02

Seat-integrated Side Airbag

The seat-integrated side airbags are mounted on the F01/F02 for the purpose of achieving optimum interior functionality, an appealing design while satisfying high safety requirements.

The side airbags are folded, together with the inflator assembly (gas generator) in a plastic housing. The airbag module is secured into the backrest and concealed by the rear panel.

The side airbag is triggered in response to a sufficiently strong impact from the side. The side airbag emerges between the seat backrest and the rear panel and inflates between the door and occupant.

The air cushion between the door and occupant provides controlled impact damping and therefore reduces the load on the occupant.

Side airbag (1) integrated in the seat

Active Head Restraint

Used on previous BMW vehicles since 09/2007, the Active head restraints are now installed on the F01/F02.

This Active Head Restraints incorporate a pyrotechnical actuator and spring elements for adjustment.

In the event of a rear-end collision, the active head restraint reduces the distance between the head and the head restraint before the occupant moves backwards. This reduces the risk of injury to the cervical vertebrae, even in the event of a small accident.

Triggering in the event of a rear-end collision

The crash safety module detects via sensors whether a rear-end collision has occurred. If there is an appropriately severe crash, the active head restraints are triggered. This can even occur in the case of a slight rear-end collision.

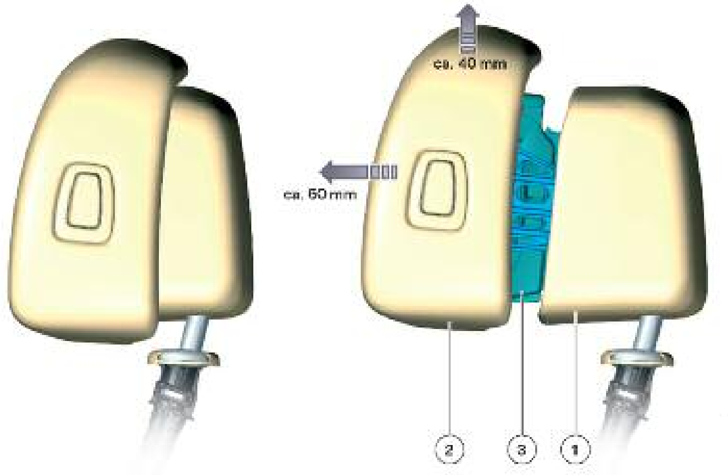
If the crash safety module detects a massive rear-end collision, other safety components, such as e.g. the belt tensioner and the safety battery terminal are also activated.

The crash safety module deploys the active head restraint, by igniting the head restraint actuator squib.

The actuator releases the head restraint spring force by activating the release plate. This enables the front section of the head restraint to be moved towards the front by means of a spring.

The head restraint drive springs are only locked again once the pyro-actuator has been replaced.

Note: If the active head restraints have been triggered, the pyro-actuators must be replaced. Please refer to the repair instructions available in ISTA or TIS for more information.

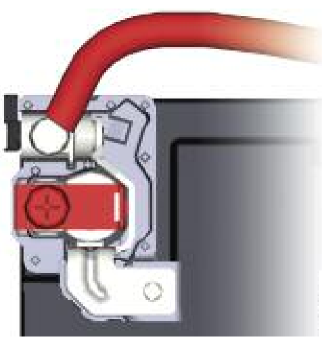


The active head restraint on the left, normal position,
The active head restraint on the right, after triggering

Index	Explanation	Index	Explanation
1	Head restraint support	3	Head restraint drive
2	Front section of the head restraint		

Automatic seat belt tensioner with adaptive force limiter
The belt force limiter on the F01/F02 works according to the same principle as on the one used on the E65/E66.

Safety Battery Terminal
The safety battery terminal is triggered at different thresholds when the Crash Safety Module detects a front-end, side-on or rear-end crash of sufficient severity. The connection between battery and starter/alternator cable is then separated with the use of pyrotechnics. The safety battery terminal is located directly at the positive terminal of the battery.



Safety battery terminal

Airbag Warning Lamp
The airbag warning lamp (AWL) is located in the instrument cluster. ACSM system operability is indicated by the AWL lighting up and then going out in during the predrive check. The AWL is controlled by means of a signal from the ACSM to the instrument cluster on the PT-CAN. The instrument cluster receives a signal on a cyclical basis. If the signal fails to materialize, the AWL is activated.

Airbag warning lamp

Passenger Airbag OFF Light
In the F01/F02, the passenger airbag OFF lamp is located at the front of the roof function center FZD next to the interior lights.

The Passenger Airbag OFF light is continuously illuminated until the OC3 mat detects an object or passenger of adequate mass and weight distribution.

The brightness of the Passenger Airbag OFF light is regulated by the automatic display lighting.

Roof function center with passenger airbag OFF light

Electric Motor Driven Reel

Debuting in the F01/F02, an electric motor driven reel (EMA) is used for the front seat belts. The electric motor driven reel is paired with the multifunction seat.

The electric motor driven reel reduces seat belt slack when fastening the seat belt using low retracting force as soon as the doors are closed. Removing the belt slack ensures that the seat belt fits the driver or front passenger. Thus better restraining action can be provided in the event of a crash.

Another advantage of the electric motor driven reel is the pretensioning to the occupants before a possible accident with increased retracting force, thus also reducing the incidence of slipping out of the belt and the risk of submarining.

The dynamic driving control sensors in the ICM (Integrated Chassis Management) record data such as longitudinal acceleration and lateral acceleration, yaw rate, etc. The ICM passes on the data via the PT-CAN to the two EMA control units. The DSC also delivers information such as speed and brake pressure. The ACSM sends a message about the status of the belt contact to the two EMA control units.

From this data, the EMA control units calculate whether there is a critical driving situation, e.g. vehicle oversteer and as a result activates the electric motor, which pretensions the seat belt.

If there is now an accident with corresponding severity, the belt tensioner is also triggered and the seat belt fastened securely to the occupants.

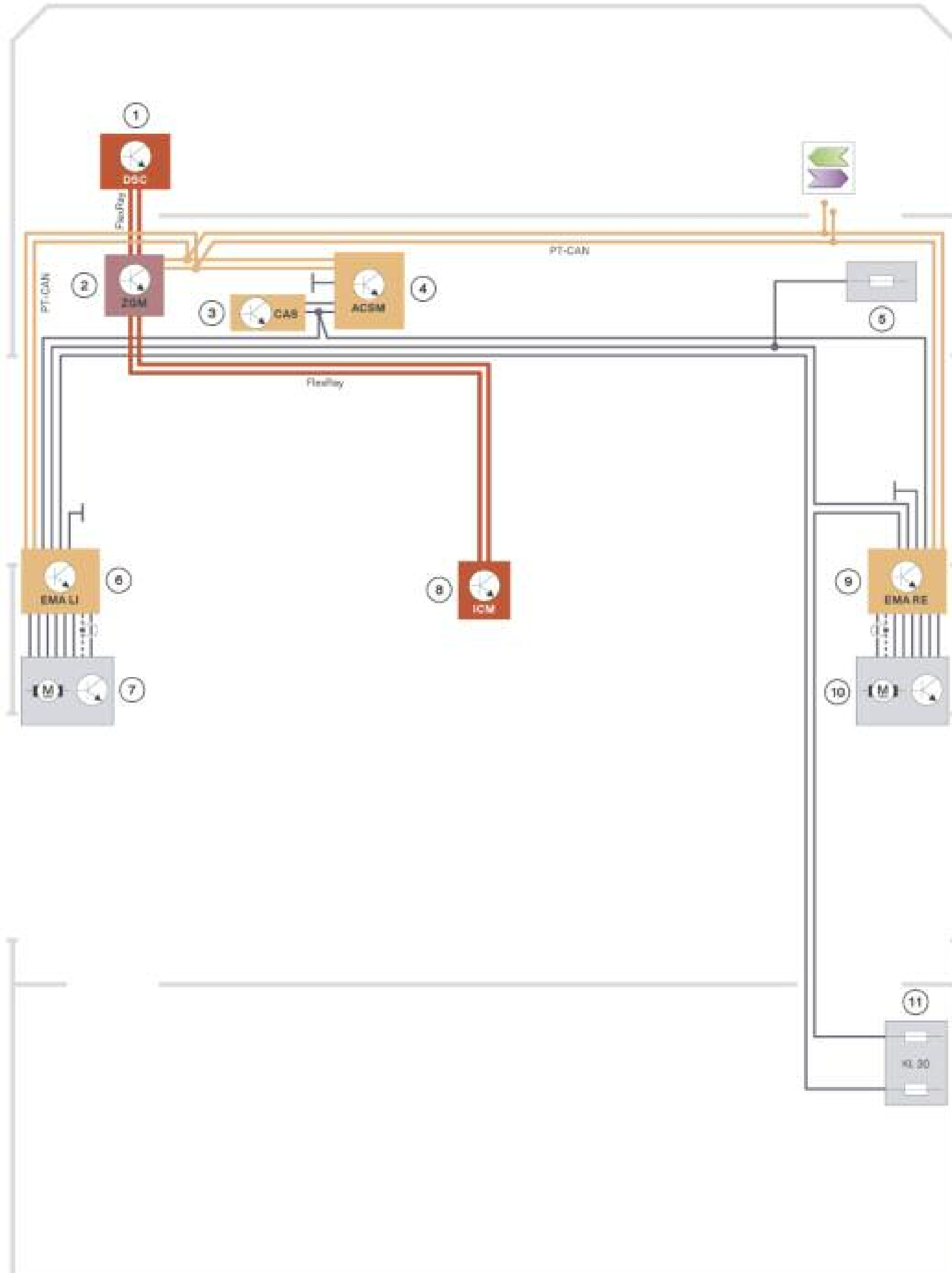
The pretensioning of the seat belt can reduce the force on the occupants in the event of an accident.

Seat belt with electric motor driven reel

Index	Explanation
1	EMA control unit
2	Electric motor
3	Automatic reel
4	EMA drive unit

NOTES PAGE

EMA Circuit Diagram



Index	Explanation
1	Dynamic stability control (DSC)
2	Central gateway module (ZGM)
3	Car Access System (CAS)
4	Crash safety module (ACSM)
5	Junction Box Electronics (JB)
6	Control unit, electric motor driven reel, left
7	Electric motor driven reel, left
8	Integrated Chassis Management
9	Control unit, electric motor driven reel, right
10	Electric motor driven reel, right
11	Luggage compartment junction box

Bus Signals

in/out	Information	Source/sink	Function
In	Terminal control	CAS > EMA LE/ EMA RI	Status terminal 30b
In	Vehicle speed	DSC > EMA LE/ EMA RI	Vehicle speed
In	Braking torque	DSC > EMA LE/ EMA RI	Emergency braking detection
In	Yaw speed	ICM > EMA LE/ EMA RI	Detection of skidding tilt
In	Steering angle effective at the front axle	ICM > EMA LE/ EMA RI	Steering effort
In	Longitudinal acceleration	ICM > EMA LE/ EMA RI	Acceleration
In	Lateral acceleration	ICM > EMA LE/ EMA RI	Lateral acceleration
In	Accelerator pedal angle	DME > EMA LI/ EMA RE	Driver power request
In	Belt contact status	ACSM > EMA LE/ EMA RI	Information whether the seat belt is fastened.
In	Door contact	FRM > EMA LE/ EMA RI	Information whether the doors are closed

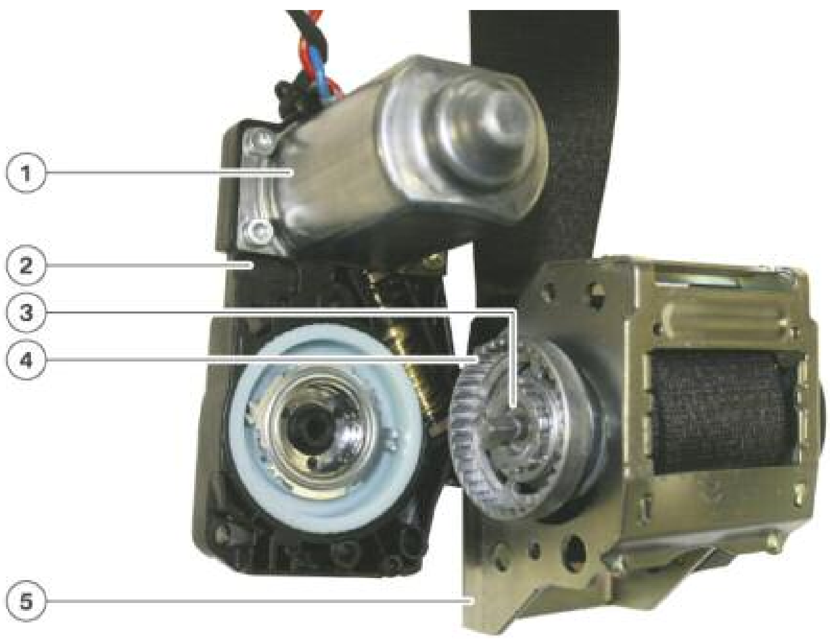
Design and function of the electric motor driven reel

The electric motor driven reel is an extension of the functions of the existing automatic reel.

The automatic reel is combined with the (pyrotechnic) adaptive belt force limiter as on E65/E66.

The electric motor driven reel essentially consists of an electric motor, a drive unit and a coupling, which establishes the connection to the automatic reel.

Components of the electric motor driven reel



Index	Explanation	Index	Explanation
1	Electric motor	4	Ring gear
2	Drive unit	5	Automatic reel
3	Belt shaft		

Electric motor driven reel, not working

The following image shows the design of the drive unit in detail. Image (A) shows the locking pawls are retracted.

Image (B) shows the drive unit with ring gear.
The ring gear and the belt shaft can rotate freely and the seat belt can be pulled out or rolled up.

Drive unit with separate components (A) and freely rotatable ring gear (B)

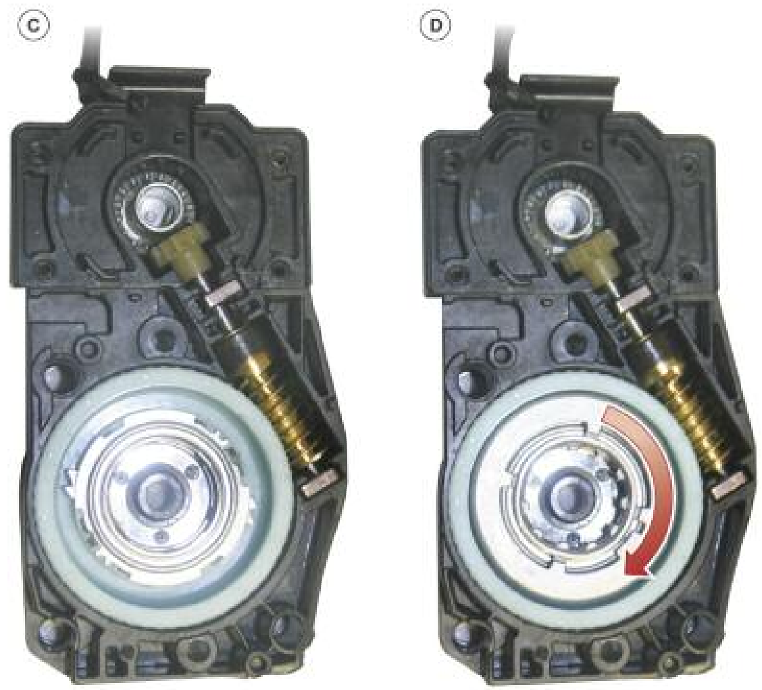
Index	Explanation	Index	Explanation
1	Drive gear for the electric motor	3	Worm gear
2	Drive gear for the drive shaft	4	Drive wheel with coupling

Electric motor driven reel, in operation

When the driver or front passenger fastens their seat belt or there is a critical driving situation in terms of driving dynamics, the electric motor is activated, this moves the drive shaft using the worm gear.

The worm gear turns the drive wheel with the coupling.
The locking pawls move out and engage in the ring gear (C).

The ring gear, which is located on the belt shaft, drives the belt shaft (D).
The seat belt is rolled up on the belt shaft and thereby shortened.
This tensions the seat belt to the occupants.

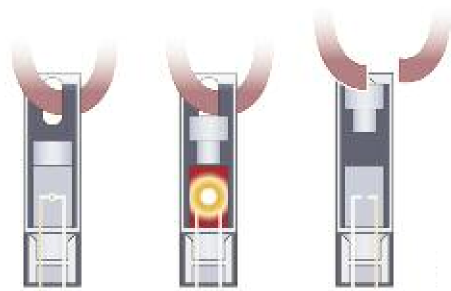


Locking pawls move out (C) and the ring gear turns the belt shaft (D)

Workshop Exercise - ACSM 3

Using an instructor assigned F01/F02 vehicle and the ISTA diagnostic equipment, answer the following questions.

1) What is the purpose for the device shown in the illustration below?



2) How many airbag sensors are located in the Central Sensor used in the ACSM 3 system?

Circle the best possible answer.

Five **Seven** **Three**

3) *List all the sensors located in the Central Sensor below*

4) What functions does the EMA motorized seat belt system perform in the F01/F02?

5) Where is the ACSM control unit and why was it relocated?

6) Where are the side airbags located in the F01/F02?

Circle the best possible answer.

Front Seats **Front Door**

7) Which airbags use the active vent valve system on the F01/F02?

Classroom Exercise - Review Questions

1. What is the main difference between the ACSM on the E70 and the ACSM 3 of the F01/F02?

2. Which control unit gives the signal to activate the EMA motors in a hazardous situation?

3. How many pyrotechnic actuators are fitted on the F01/F02 ACSM 3 system?

4. When is the active vent valve opened?

5. What is the volume of the knee airbags used on the F01/F02?

Active Blind Spot Detection (SWW)

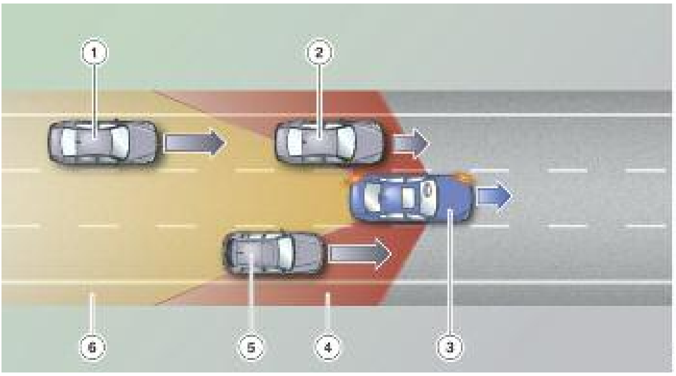
Active Blind Spot Detection is a new BMW system and It is being introduced for the first time in the F01/F02 7 Series . The system is designed to assist the driver in making lane change maneuvers by monitoring traffic at the rear and sides of the vehicle.

Using two radar sensors it detects vehicles traveling in the rear and along side our vehicle and warns the driver of the position of any unseen vehicles around him traveling in his “Blind Spot”.

The active blind spot detection system can detect traffic situations that could be dangerous if your vehicle changes lanes.

The driver is informed and warned in two stages.

These kinds of traffic scenarios arise, for example, when distant vehicles rapidly approach from behind. They are then in the "lane change zone" shown in the graphic.



Index	Explanation
1	Vehicle approaching on the left-hand neighboring lane
2	Vehicle in the left-hand neighboring lane travelling at your same speed
3	Your own vehicle, with the intention of changing lanes to the left
4	Blind spot area (left/right)
5	Vehicle in the right-hand neighboring lane travelling at a faster speed
6	"Lane change zone"

These kinds of situations are difficult for the driver to judge, especially after dark. The radar sensors work completely independently of the light conditions.

A second danger can arise if other vehicles are in the blind spot area. The driver can only be aware of them if he is particularly careful and cautious. However, If he has a lapse of attention, he may not see vehicles in this area.

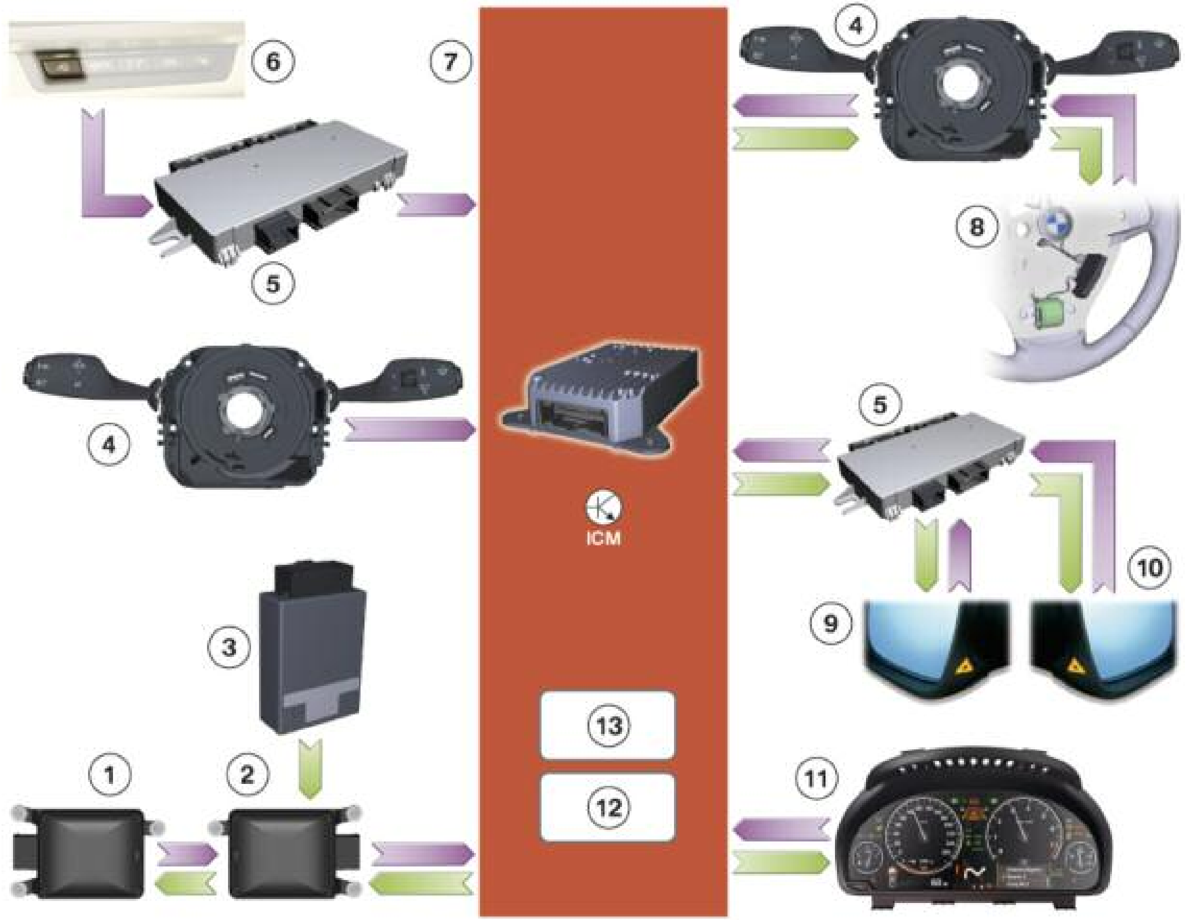
The radar sensors of the active blind spot detection system detect other vehicles in the neighboring lanes right up to about the middle of your own vehicle.

The first stage of detection is called "information" and it is provided as soon as the system is switched on and a hazardous lane change situation is present. The information is provided by activating warning lights in the door mirrors.

If the driver intends to make a lane change in this scenario and uses the turn signal stalk to indicate this, a second, more intense stage will then be issued, the "warning". The corresponding warning light then flashes with high intensity and the steering wheel starts to vibrate. The driver must cancel the lane change and if necessary steer back into his own lane to avoid a dangerous situation.

Note: The US marketing term for Lane Change Warning System (SWW) is Active Blind Spot Detection. These two systems are one and the same and are not to be confused with Lane Departure Warning

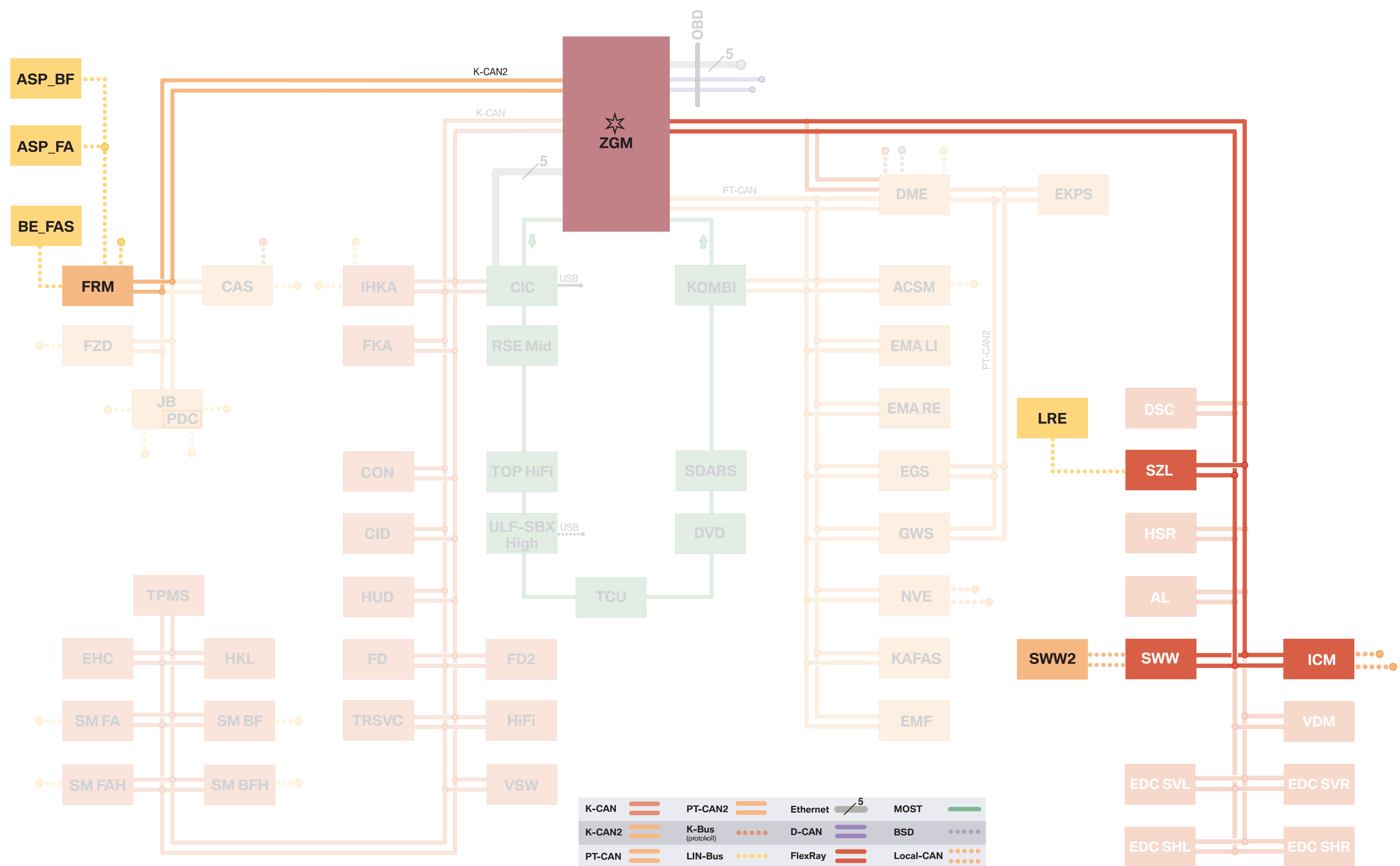
System Overview



Blind Spot detection system input/output

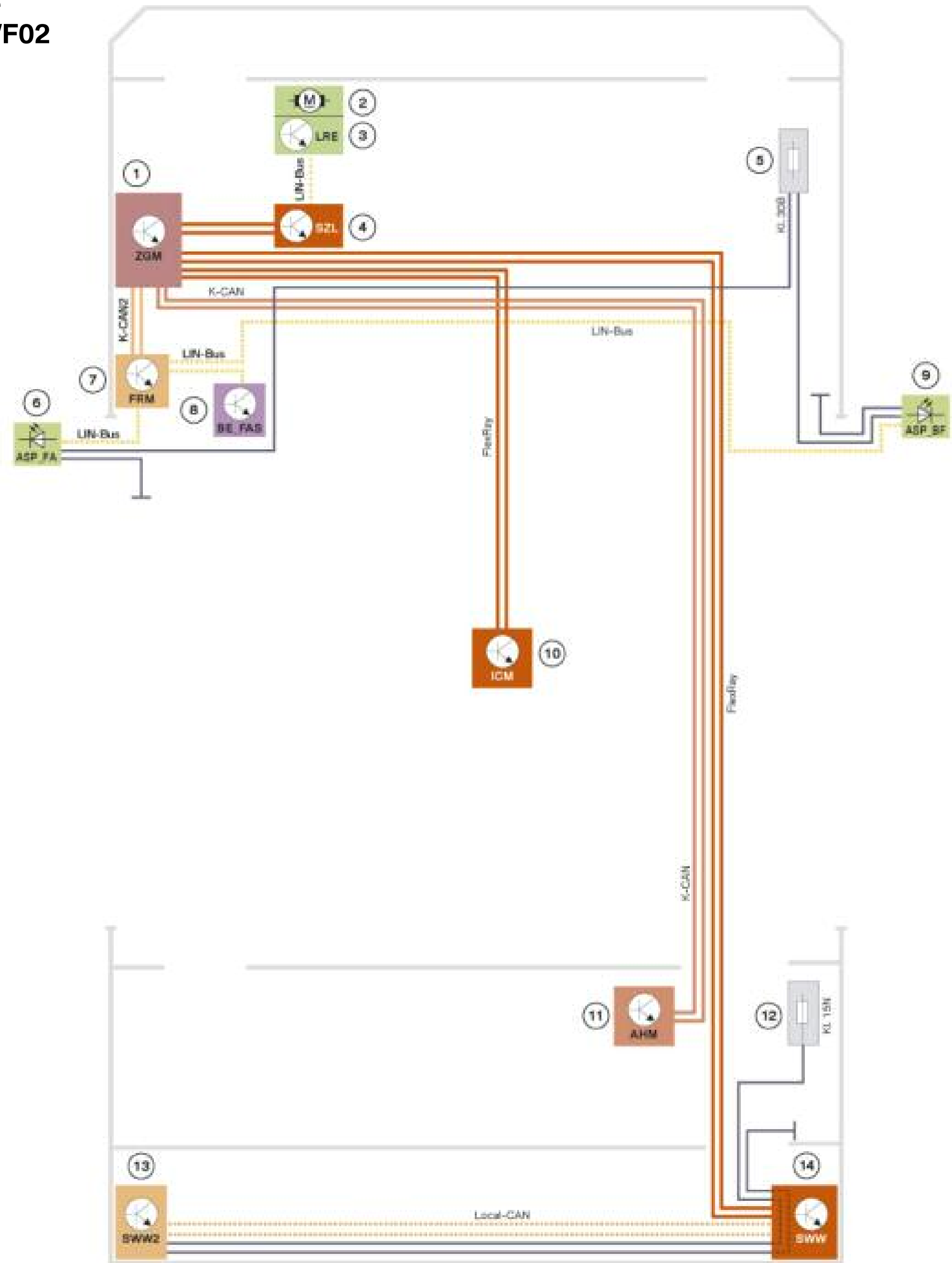
Index	Explanation	Index	Explanation
1	SWW2 Radar sensor (Secondary controller)	8	Steering wheel module and vibration actuator
2	SWW Radar sensor (Master)	9	Driver's door mirror
3	Not for US	10	Front passenger door mirror
4	Steering column switch cluster	11	Instrument cluster
5	Footwell module	12	"Active Blind Spot Detection control unit function"
6	Operating unit for driver assistance systems	13	"Steering wheel vibration coordination" function
7	Integrated Chassis Management		

Bus system overview of the lane change warning system in the F01/F02



Index	Explanation
ASP_BF	Front passenger door mirror
ASP_FA	Driver's door mirror
BE_FAS	Operating unit for driver assistance systems
FRM	Footwell module
ICM	Integrated Chassis Management
LRE	Steering wheel module
SWW	SWW radar sensor for the Active Blind Spot Detection system
SWW2	SWW2 radar sensor for the Active Blind Spot Detection system
SZL	Steering column switch cluster
ZGM	Central gateway module

System circuit diagram for the lane change warning system in the F01/F02



Index	Explanation
1	Central gateway module
2	Vibration actuator
3	Steering wheel module
4	Steering column switch cluster
5	Fuse for the driver/front passenger door mirrors (front fuse carrier, junction box electronics)
6	Warning light in the driver's door mirror
7	Footwell module
8	Operating unit for driver assistance systems
9	Warning light in the front passenger door mirror
10	Integrated Chassis Management
11	(Not for US)
12	Fuse for the radar sensors in the Active Blind Spot Detection system (rear fuse carrier in the luggage compartment)
13	SWW2 radar sensor for the Active Blind Spot Detection system
14	Master radar sensor for the Active Blind Spot Detection system

Switching the System On and Off

How the Active Blind Spot Detection system behaves with regard to the driver is ultimately controlled by the Integrated Chassis Management.

This includes:

- Switching it on and off
- Checking the operating conditions
- Checking for faults
- Distinguishing between information and a warning.

A button on the operating unit for the driver assistance systems is used to switch it on and off. The ICM control unit receives the signal by keystroke from the footwell module.

The ICM control unit permits it to be switched on only if no fault is present in the interconnected system and all operating conditions are satisfied.

If the ICM control unit carries out the driver's request to switch it on, the function illumination on the button is switched on as visual confirmation. This is also controlled by the Integrated Chassis Management and is executed by the FRM.

If the request to switch it on cannot be carried out, the function illumination remains off. The status (switched on or off) remains key specific regardless of power cycles. If the Active Blind Spot Detection system is on in the current driving cycle, it will be on in the next driving cycle from the start.

If, after switching on the Active Blind Spot Detection, one of the operating conditions is infringed or a fault occurs, it is automatically deactivated. In such a case, the driver would not be able to tell if only the function illumination had switched off. Therefore, a Check Control message is issued.

Informing and Warning

The information is issued to the driver in all cases where all of the following conditions have been satisfied:

- The Active Blind Spot Detection system is switched on
- The road speed is above 50km/h/ 31mph
- The master radar sensor has detected a necessity for a warning.

The second stage, the warning, should, in comparison, be significantly more prominent than the information. It should reach the driver quickly and directly, if he is still intending to make a lane change despite an impending dangerous situation.

The warning is issued, if the following conditions have been satisfied:

- The conditions for information have been satisfied:
- The turn signal is switched on the side of the vehicle where the master radar sensor detected a necessity for a warning.

The steering column switch cluster issues the signal about the status of the turn signal via the FlexRay to the ICM control unit.

The only difference in the criteria for information and a warning is thus the status of the turn signal. The rear traffic situation or your own driving conditions do not influence it.

The visual aspect of the warning is generated by the respective warning light flashing with a high light intensity. In addition, the steering wheel begins to vibrate and this produces a very direct warning signal to the driver.

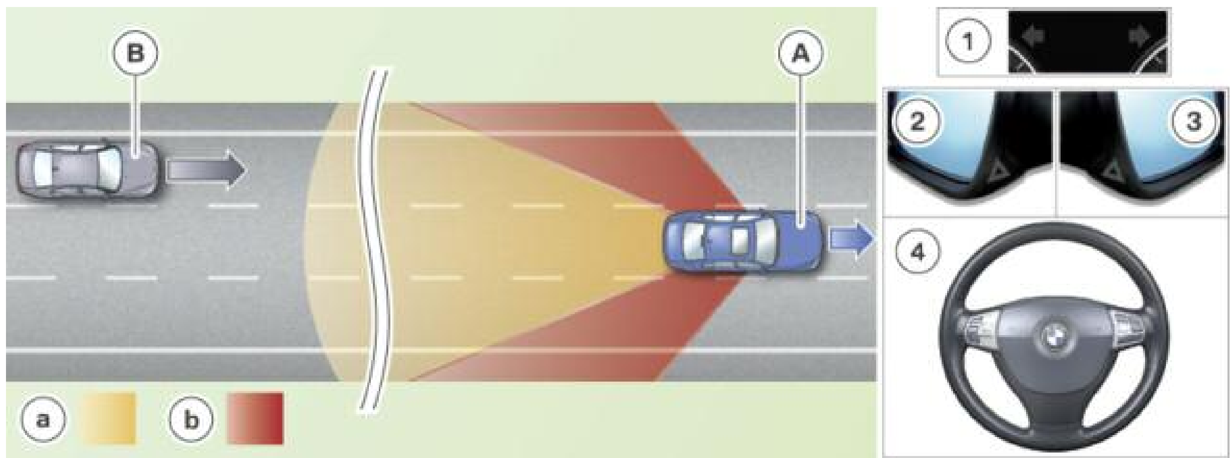
No Necessity for a Warning

Although another vehicle in the left-hand lane is approaching your own vehicle, neither information or a warning is generated. Even if at this moment the driver were to carry out a lane change, this would not result in a dangerous situation. The time it would take for the other vehicle to reach your own vehicle is considerable.

A sufficient distance will be maintained by accelerating your own vehicle slightly or by a slight deceleration of the other vehicle.

There is no necessity at all for the driver to be informed by the Active Blind Spot Detection system.

Traffic scenario without the a need for a warning



Index	Explanation
A	Your own vehicle with blind spot detection ON
B	Faster vehicle in the left-side neighboring lane outside of the lane change zone
a	Lane change zone
b	Blind spot area
1	Turn signal OFF
2	Warning light in the driver's door mirror OFF
3	Warning light in the front passenger door mirror OFF
4	Steering wheel not vibrating

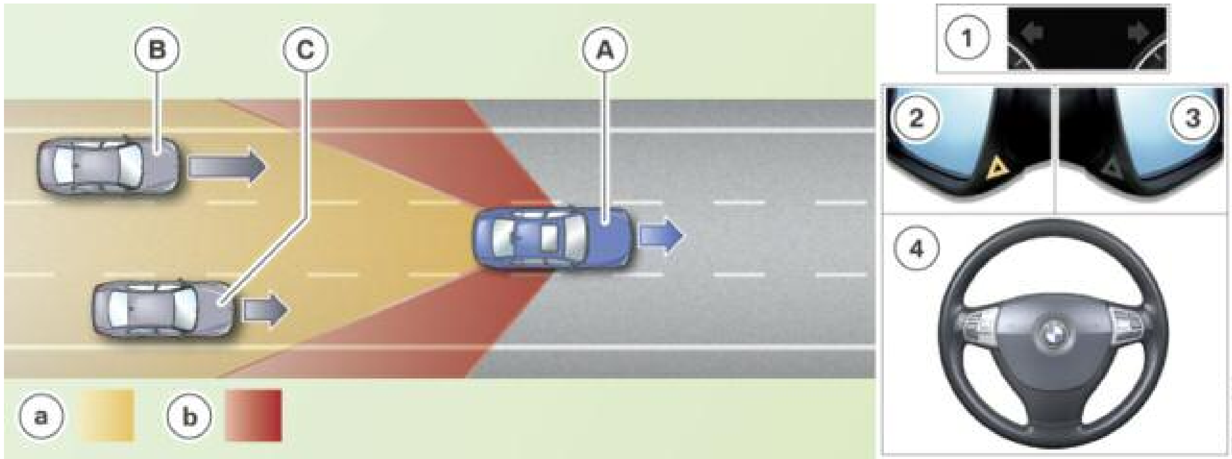
Information Stage

The vehicle (B) in the neighboring left-hand lane is already in the lane change zone. Because it is still approaching your own vehicle (A) at a high speed, the time the driver would have to cancel a lane change maneuver is very short. The blind spot detection system recognizes the necessity for a warning. Because the driver does not show any specific intention of making a lane change (turn signal off), only the information and not the warning is issued.

The vehicle (C) in the right-side neighboring lane is at a some what shorter distance from your own vehicle than the vehicle in the left side neighboring lane. Because it is travelling at the same speed as your own vehicle and the distance to your own vehicle is therefore not decreasing, there is no need to issue a warning on the right side.

In this case only the warning light in the driver's door mirror lights up and it does this with low intensity to just “inform” the driver.

Traffic scenario with information from the blind spot detection system



Index	Explanation
A	Your own vehicle with blind spot detection ON
B	Fast approaching vehicle in the left-side neighboring lane within the lane change zone
C	Equally fast vehicle as your own traveling in the right-side neighboring lane, within the lane change zone
a	Lane change zone
b	Blind spot area
1	Turn signal OFF
2	Warning light in the driver's door mirror lights up with low intensity
3	Warning light in the front passenger door mirror OFF
4	Steering wheel not vibrating

Warning Stage

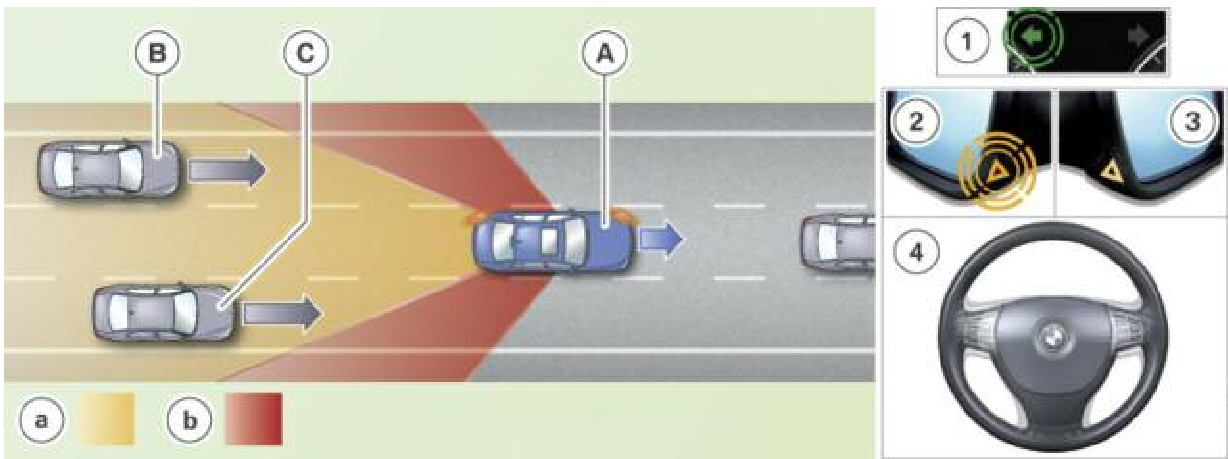
The vehicle (B) in the left-hand neighboring lane is in the lane change zone and is approaching your own vehicle (A). There is a necessity for a warning therefore on the left-hand side.

Because the driver intends to make a lane change to the left, he has switched on the left turn signal. A lane change maneuver is therefore imminent. In order to attract the attention of the driver quickly and directly, a left-side warning is produced.

This means the warning light in the driver's door mirror flashes brightly and in addition the steering wheel vibrates.

The vehicle (C) in the right-side neighboring lane is also approaching your own vehicle at this point. Therefore, the necessity for a warning also exists on the right-hand side. However, because the driver has not switched on the right turn signal, just the information stage is issued to this side, but no warning.

Traffic scenario with a warning from the blind spot detection system



Index	Explanation
A	Your own vehicle with blind spot detection ON
B	Fast approaching vehicle in the left-side neighboring lane, within the lane change zone
C	Equally fast vehicle as vehicle (B) in the right-side neighboring lane also within the lane change zone
a	Lane change zone
b	Blind spot area
1	Left turn signal ON
2	Warning light in the driver's door mirror flashes with high intensity (Warning Stage)
3	Warning light in the front passenger door mirror lights up with low intensity (Information Stage)
4	Steering wheel is vibrating

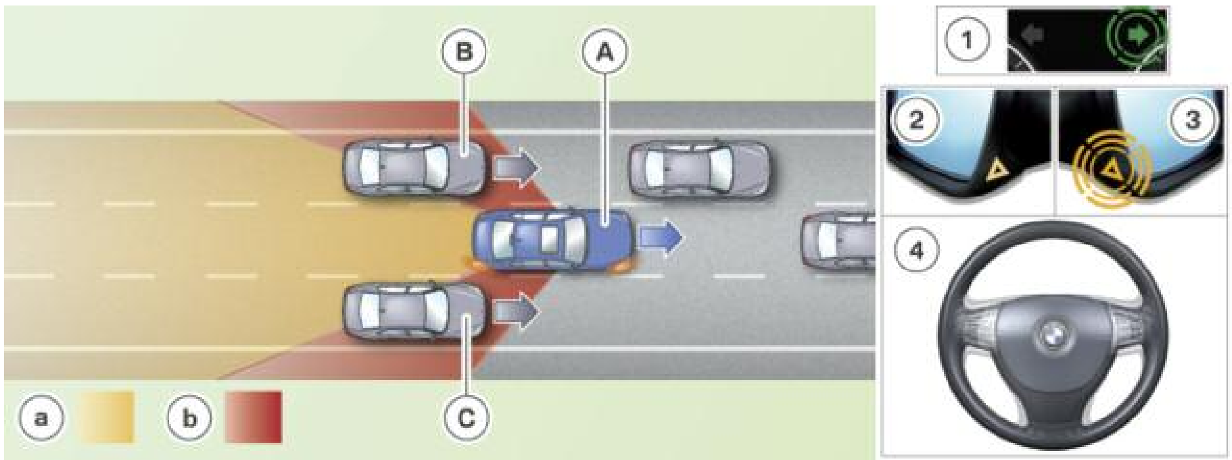
Warning - Blind Spot Area

Both, the vehicle (B) on the left side and the vehicle (C) in the right-side neighboring lanes are in your car's blind spot area. Therefore, the necessity for a warning exists on both sides, independently of how quickly they are travelling.

The driver (A) intends to make a lane change to the right and therefore switches on the right turn signal. This causes the right-side warning to be produced. The warning light in the front passenger door mirror flashes brightly and the steering wheel vibrates.

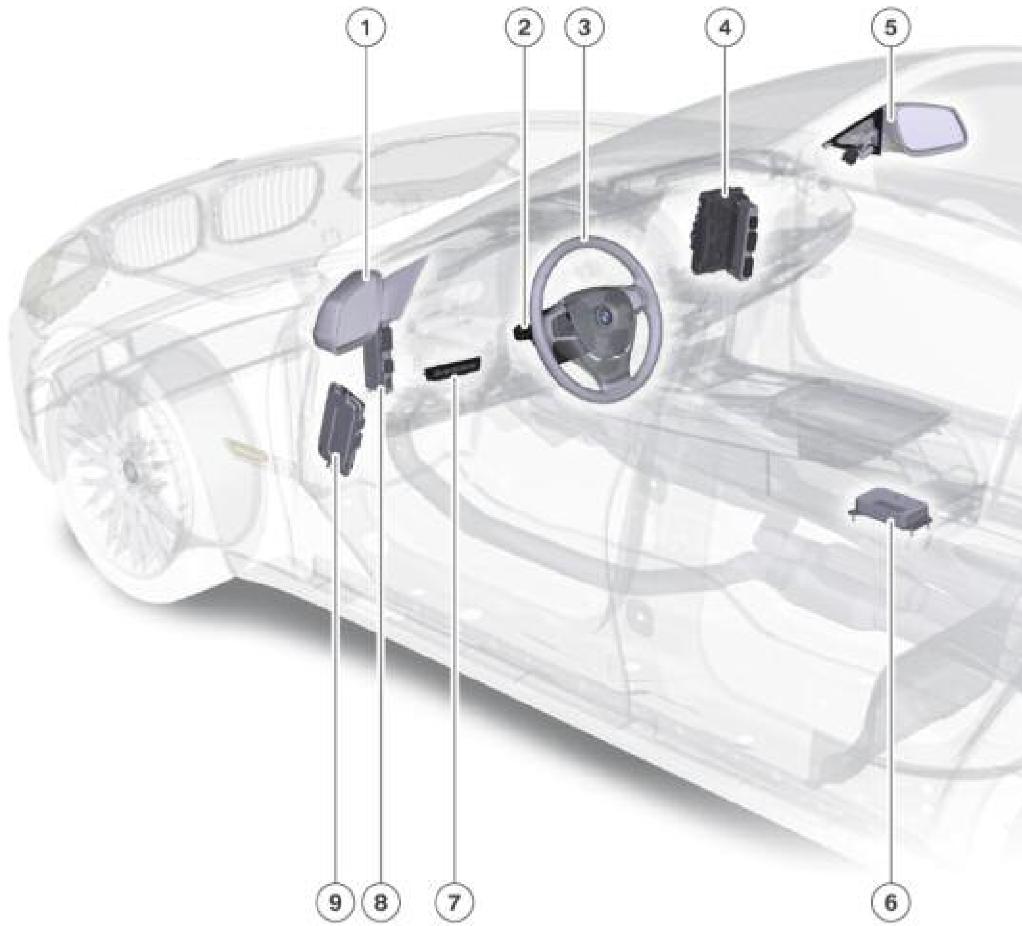
In this case the "Information stage" is displayed on the left side mirror, but no warning issued.

Traffic scenario with vehicles in the blind spot



Index	Explanation
A	Your own vehicle with blind spot detection ON
B	Vehicle in the left-side neighboring lane in the blind spot area
C	Vehicle in the right-side neighboring lane in the blind spot area
a	Lane change zone
b	Blind spot area
1	Right turn signal ON
2	Warning light in the driver's door mirror lights up with low intensity (Information Stage)
3	Warning light in the front passenger door mirror flashes with high intensity (Warning Stage)
4	Steering wheel vibrates

System Components

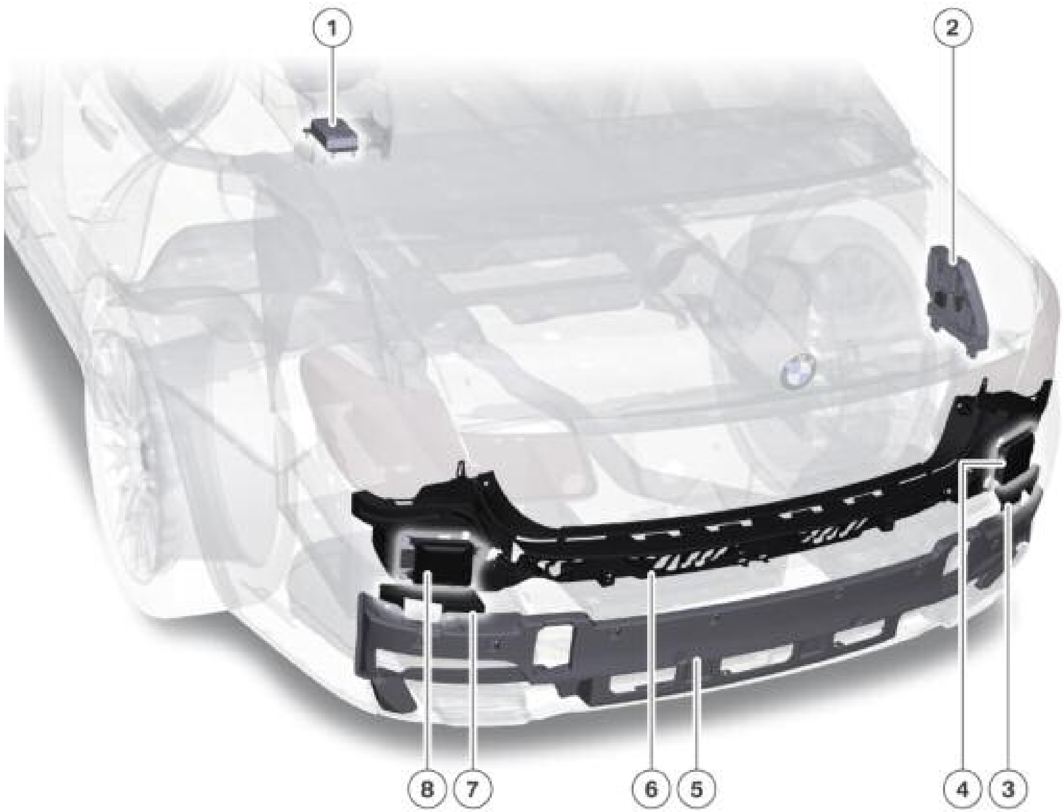


Components of the Active Blind Spot Detection system in the F01/F02

Index	Explanation
1	Driver's door mirror
2	Steering column switch cluster
3	Steering wheel with steering wheel module and vibration actuator
4	Junction box electronics and front fuse carrier
5	Front passenger door mirror
6	Integrated Chassis Management control unit
7	Operating unit for driver assistance systems
8	Central gateway module
9	Footwell module

Note: The US marketing term for Lane Change Warning System (SWW) is Active Blind Spot Detection. These two systems are one and the same and are not to be confused with Lane Departure Warning.

Components of the Active Blind Spot Detection system in the F01/F02 (rear half of the vehicle)



Index	Explanation
1	Integrated Chassis Management control unit
2	Rear fuse carrier in the luggage compartment
3	Bracket for shielding the right-hand radar sensor
4	Right-hand master radar sensor (SWW)
5	Rear bumper deformation elements
6	Center guide
7	Bracket for shielding the left-hand radar sensor
8	Left-hand SWW2 radar sensor

Radar Sensors

Two radar sensors are fitted in the vehicle for the Active Blind Spot Detection system.

The two parts are different, although visually they look the same. There is a main radar sensor (SWW) that is always fitted in the rear of the vehicle on the right side, as well as the SWW2 radar sensor that is fitted in the rear left-hand side.

The sensors of the Active Blind Spot Detection system work according to the RADAR principle (radio detection and ranging). They have some features in common with the short-range radar sensors for the ACC Stop & Go function. Although the radar sensors for Active Blind Spot Detection (SWW) and the short range radar sensors for ACC Stop & Go use the same frequency of 24GHz, the bandwidth is different for both systems. SWW uses a bandwidth of 100MHz and ACC Stop & Go uses >1GHz.

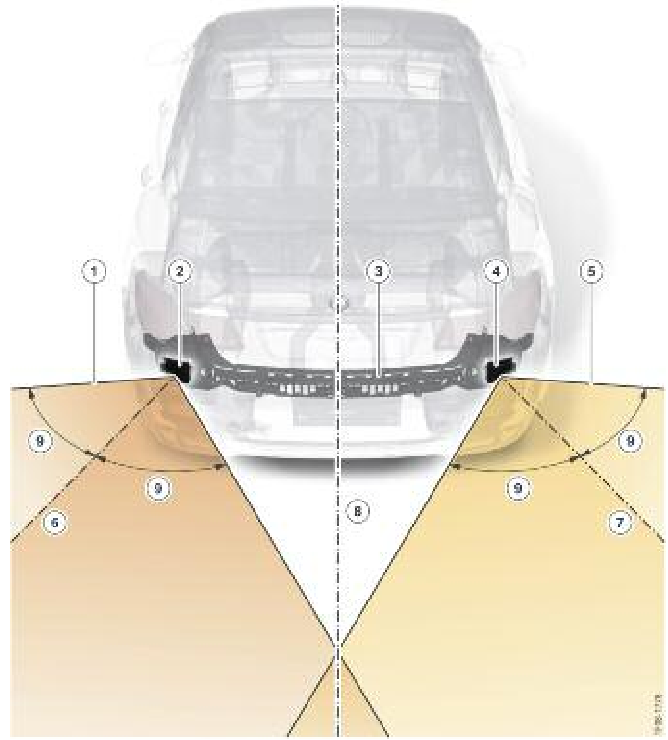
The RADAR principle offers basic advantages with regard to the detection reliability of road users in poor weather conditions. Only when it is exposed to extreme conditions, for example heavy rain or snow, can a reduction in its range occur. If the sensors detect a particularly extreme situation, this status is signalled so that the function can be switched off and the driver informed.

Both sensors have the functionality of control units. This means that they are compatible with diagnostics and can be programmed and coded.

The sensors are fitted in the rear of the vehicle above the bumper bracket. They are fitted to a large plastic component that is referred to as the "center guide". From the outside, the sensors are not visible because they are hidden by the bumper trim.

Note: For more information, see the F01 "Active Blind Spot Detection" training reference material available on ICP or TIS.

Overview and installation location of the radar sensors



Index	Explanation	Index	Explanation
1	Detection zone of the SWW2 radar	6	Symmetrical axis of SWW2
2	SWW2	7	Symmetrical axis of the master
3	Center guide	8	Vehicle longitudinal axis
4	Master (SWW)	9	Horizontal angular width of beam
5	Detection zone of the master radar		

As you can see from the graphic, the detection zones of the two sensors overlap. The data on road users that have been detected can therefore not be evaluated separately from each other (for the left and right side of the vehicle). Instead the data is first collected from both sensors and evaluated. Then a decision is made whether the driver must be warned or not.

The fixtures for the sensors do not permit any mechanical adjustment. Instead of the sensors being mechanically adjusted (as is the case with the long-range area sensor in the ACC), they are calibrated using software. When this is done, the actual installation position and above all the alignment of the center axes of the sensors are determined and stored in the sensors. For details please see the section entitled "Calibrating the radar sensors".

Two brackets are fitted to the deformation element of the rear bumper that act as a shield for the radar sensors. This prevents malfunctions when processing radar signals that could be caused, for example, by reflections from the road surface. The material used for the bracket was specially selected for this intended use. Therefore, in the event of damage to the brackets, they must be replaced with the correct new part.

Emergency repair using a different plastic part is not permitted. Both radar sensors have a similar structure. The connector and the electronics board are located on the lower section of housing. It is used both for electrical shielding and for dissipating heat.

The board always has a signal processor. This evaluates the radar signals and uses them to generate a list of the objects detected by the sensor. The list contains the distance to each object in a longitudinal and lateral direction and the relative speed. In addition, information is supplied about whether the object is in the blind spot area.

The radar front-end (radome) is used to generate and send radar waves. A receive circuit is also integrated in the sensor. Sending and receiving is carried out via a planar antenna. The radar waves are transformed into the required shape using the so-called radome.

The plastic radome therefore determines exactly the extent of the detection zone of the sensors.

The bumper trim also influences the shape of the detection zone. Calibration must therefore always be done with the bumper trim mounted. If done without the bumper trim, different values are assigned to the measured distances. The measuring result would be distorted and the warning for the driver inappropriate.

The radome and the lower section of housing are cemented together. Repairs to the inside of the sensor are not intended. If the test plan of the diagnostic system requests it, then the sensor must be replaced.

The mounting holes of the lower housing sections on the main and are located in different positions. The fixtures for the mounting bolts on the "Center guide" are appropriately positioned. This ensures that the master is mounted only on the right and the secondary unit (SWW2) on the left. Only after installation is complete is it recommended to connect the wiring harness to the sensors.

You can also differentiate between the sensors by using the part number and by the labelling on the lower section of the housing.

Special features of the SWW2

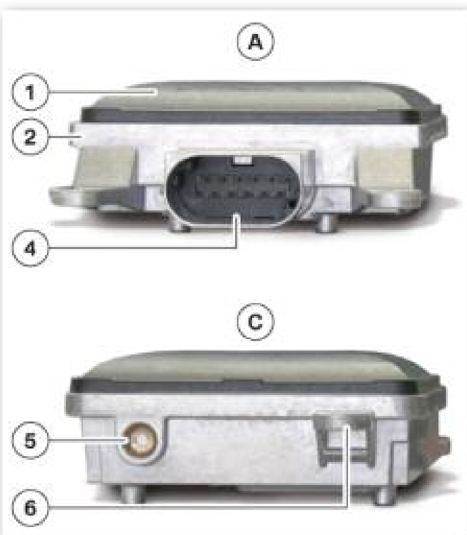
The SWW2 radar sensor only provides information about the road users in its detection zone. This is why it contains only one signal processor for controlling the radar and for evaluating the radar signals. A CAN controller is used to send the data to the master (SWW).

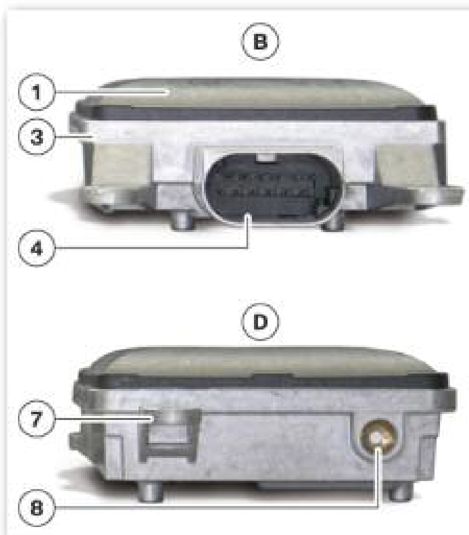
The signal processor is also capable of executing the self-diagnostics of the sensor. If SWW2 faults are detected, they are stored in its own EEPROM. They are also transferred to the master and stored there in its fault code memory.

Special features of the master (SWW)

The master radar sensor performs the same basic tasks as the SWW2 with regard to recording and evaluating data from road users. In addition, the master calculates whether a traffic scenario exists that could be dangerous in the event of a lane change. This calculation is based on data about the road users detected and the state of motion of your own vehicle. If such a situation is detected, the master sends a corresponding signal via FlexRay to the ICM control unit. In addition, the master uses the same path to send signals about the status of both sensors, for example to determine whether they are functioning correctly or there is a fault.

The master executes self-diagnostics in the same way as the SWW2. If, in the process, it detects a fault within itself or a fault is registered by the SWW2, an entry is made in the fault code memory of the master. This makes it possible to read faults with the SWW2 during servicing, even though the diagnostic system is only communicating with the master and as a result is only accessing its fault code memory. In addition to the signal processor the master contains a microprocessor for this purpose. This also carries out communication via the FlexRay controller with partner control units, and with the ICM control unit in particular.





Index	Explanation	Index	Explanation
A	Outside view of the SWW2	3	Lower section of housing, master
B	Outside view of the master	4	Connector
C	Inside view of the SWW2	5	Pressure-compensating element, SWW2
D	Inside view of the master	6	Mounting eye for the SWW2
1	Radome	7	Mounting eye, master
2	Lower section of housing, SWW2	8	Pressure-compensating element, master

Bus Connections

The sensors for Active Blind Spot Detection are connected with two bus systems:

- The SWW is connected to the FlexRay and to the local CAN.
- The SWW2 is only connected with the local CAN.

The SWW2 uses the local CAN to transmit the data of all of the road users it has detected to the master. The sensors also utilise the local CAN to exchange internal system status and control signals.

The local CAN is physically set up like the PT-CAN and therefore works at a bit rate of 500 kBit/s.

The SWW and SWW2 each have one of the two terminal resistors, each with 120 Ω.

The FlexRay represents the interface between the sensors and the whole vehicle. In this way, the sensors, or to be exact, the master sensor, receives the data about the state of motion of the vehicle (e.g. the road speed and yaw rate).

The master uses this interface to send information about whether the necessity for a warning exists to the ICM control unit.

The FlexRay is routed to the master and is fitted there with a terminating resistor. The master is therefore a terminal node in the FlexRay network.

A detailed description of new features in the FlexRay network can be found in the F01/ F02 bus systems training material in ICP and TIS.

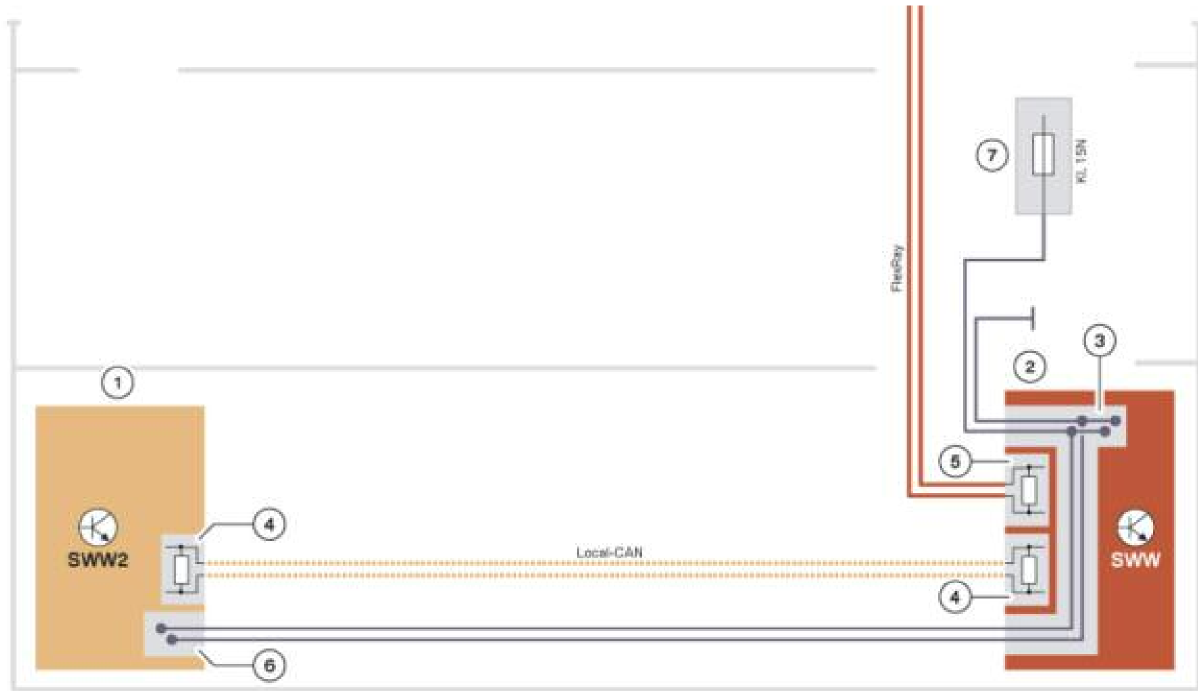
Voltage Supply

The SWW sensors is supplied with power via a common fuse with terminal 15. The fuse is located in the rear fuse carrier (in the luggage compartment). The voltage supply is routed to the master and from there to the SWW2.

The wake-up line is therefore not required on the SWW sensors.

During the overrun of terminal 15 the SWW sensors save important data in the integrated EEPROM. This includes, for example, fault code memory entries and values calculated during calibration. Only after this is this data permanently stored and available again for the next driving cycle. It is therefore important to wait for the overrun from terminal 15 when work is carried out on the SWW sensors, before disconnecting the voltage supply (connector, battery).

Bus systems and voltage supply to the radar sensors of the blind spot detection system



Index	Explanation	Index	Explanation
1	SWW2 radar sensor	5	FlexRay feed line with a terminating resistor
2	Master radar sensor	6	Voltage supply feed line (terminal 15 and ground)
3	Feed line and continuation of the voltage supply (terminal15 and ground)	7	Fuse for SWW sensors (rear fuse carrier in the luggage compartment
4	Local CAN feed line with a terminating resistor		

Warning light in the driver's door mirror

There is a triangular-shaped warning light in the left and right door mirror. This lights up two-dimensionally and can be activated in different intensities.

The ICM sends a request together with the requested intensity to the footwell module.

Using the LIN bus, the request is passed on to the electrical system of the respective door mirrors. Amplitude-modulated control is used to light up the LEDs in the door mirror.

Vibration actuator in the steering wheel

The vibration actuator is housed in the six o'clock spoke of the steering wheel. It causes the steering wheel to vibrate as a warning in order to alert the driver of dangerous situations.

The Lane Departure Warning and Active Blind Spot Detection systems use the same vibrating device.

The steering wheel module that controls the vibration actuator is also housed in the interior of the steering wheel. This produces an alternating voltage that causes the vibration actuator to oscillate.

The frequency of the alternating voltage is not changed during operation.

The amplitude of the alternating voltage can be changed using the steering wheel module. Therefore, you have the option of different systems with varying oscillating amplitudes available to you for the warning.

The E6x LCI is already equipped with the driver assistance system called lane departure warning which uses steering wheel vibration to warn the driver in a similar way. Here a vibration motor is used as the vibration actuator. An unbalance mass is located on the shaft.

If the vibration motor is activated, the unbalance mass rotates and thus produces the vibrations.

The vibration actuator in the F01/F02 has undergone a significant advancement in comparison with the vibration motor. Instead of the unbalance motor, a structural element is used that only oscillates in a longitudinal direction. For this reason, it is known as a "longitudinal oscillator". This active principle has the advantage that the vibrations are only induced in this one direction.

The vibration actuator is built into the steering wheel so that the direction of its oscillations correspond with the direction of rotation of the steering wheel. This provides an ideal expression of the warning and the driver is made immediately aware that he must use the steering wheel to avert the dangerous situation. In addition, this principle to a large extent avoids unwanted side-effects such as noises or oscillations that could be transferred in other directions to the body.

The two brackets connect the vibration actuator with the steering wheel. However, the brackets on the vibration actuator are not screwed to the case, but to the coil carrier.

This means the coil carrier is fixed in place. The permanent magnet can move instead. It is set into an oscillating motion in the direction shown, when alternating voltage is applied to the coil.

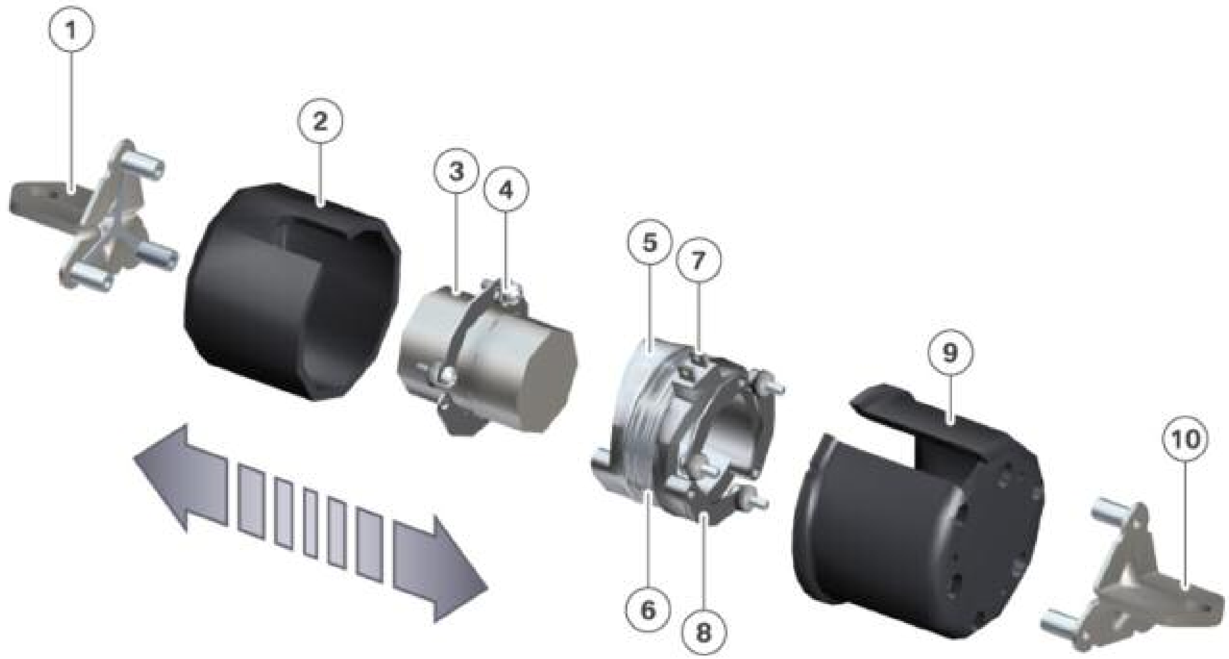
The longitudinal movement of the permanent magnet is transferred to both case sections due to its length. This is why the case sections also have a long slot in the electrical connection area to the coil.

The springs ensure that the case sections do not hit against their end positions and therefore prevent noises.

Steering wheel with vibration actuator

Index	Explanation
1	Steering wheel module (LRE)
2	Vibration actuator

Exploded view of the Vibration actuator



Index	Explanation	Index	Explanation
1	Left bracket	6	Coil
2	Left case section	7	Electrical connection
3	Permanent magnet	8	Spring
4	Spring	9	Right case section
5	Coil carrier	10	Right bracket

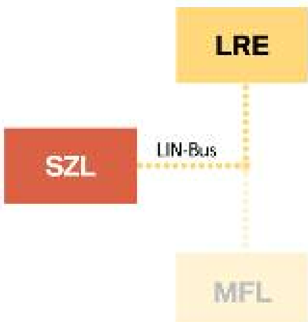
Coordinating the activation of the vibration actuator

Like the blind spot detection, the lane departure warning (KAFAS control unit) also uses the vibration actuator to produce a warning signal for the driver. For this, the systems use different amplitudes of vibration.

This is why these must be a coordinator function for controlling the vibration actuator. This is integrated into the ICM control unit.

The request to activate the vibration actuator is sent from the Integrated Chassis Management over the FlexRay to the steering column switch cluster (SZL). The SZL guides this request via LIN bus further to the steering wheel module (LRE).

LIN bus subscribers at the steering column switch cluster



Index	Explanation
LRE	Steering wheel module
SZL	Steering column switch cluster

Instrument Cluster

There are no function displays for the Active Blind Spot Detection system in the instrument cluster (different to the lane departure warning). Instead Check Control messages are displayed in the instrument cluster, when the Active Blind Spot Detection system is not available. A distinction is made between two possible causes:

	
Active Blind Spot Detection deactivated (due to functional peripheral factors such as, blindness)	Active Blind Spot Detection failure (due to real faults or defects with components)

Note: The term "Blindness" is used to describe a situation where the radar sensors are unable to detect any road users in there range.

NOTES PAGE

Classroom Exercise - Review Questions

1. Which two BMW systems use the vibration actuator?

2. How does the design of the vibration actuator used on F01/F02 differ from the previous version?

3. Where is the fuse for the active blind spot detection radars located?

4. What is the signal bus path of the “warning” to the mirrors?

5. What is the signal bus path of the “warning” to the vibration actuator?

KAFAS

Depending on the combination of the available options installed, the functions in the F01/F02 are implemented as camera-based systems, all sharing the same camera and the one control unit, the KAFAS control unit.

KAFAS is the camera-based Driver Assistance System.

The high-beam assistant option shares the KAFAS camera and the KAFAS control unit when the vehicle is equipped with the lane departure warning.

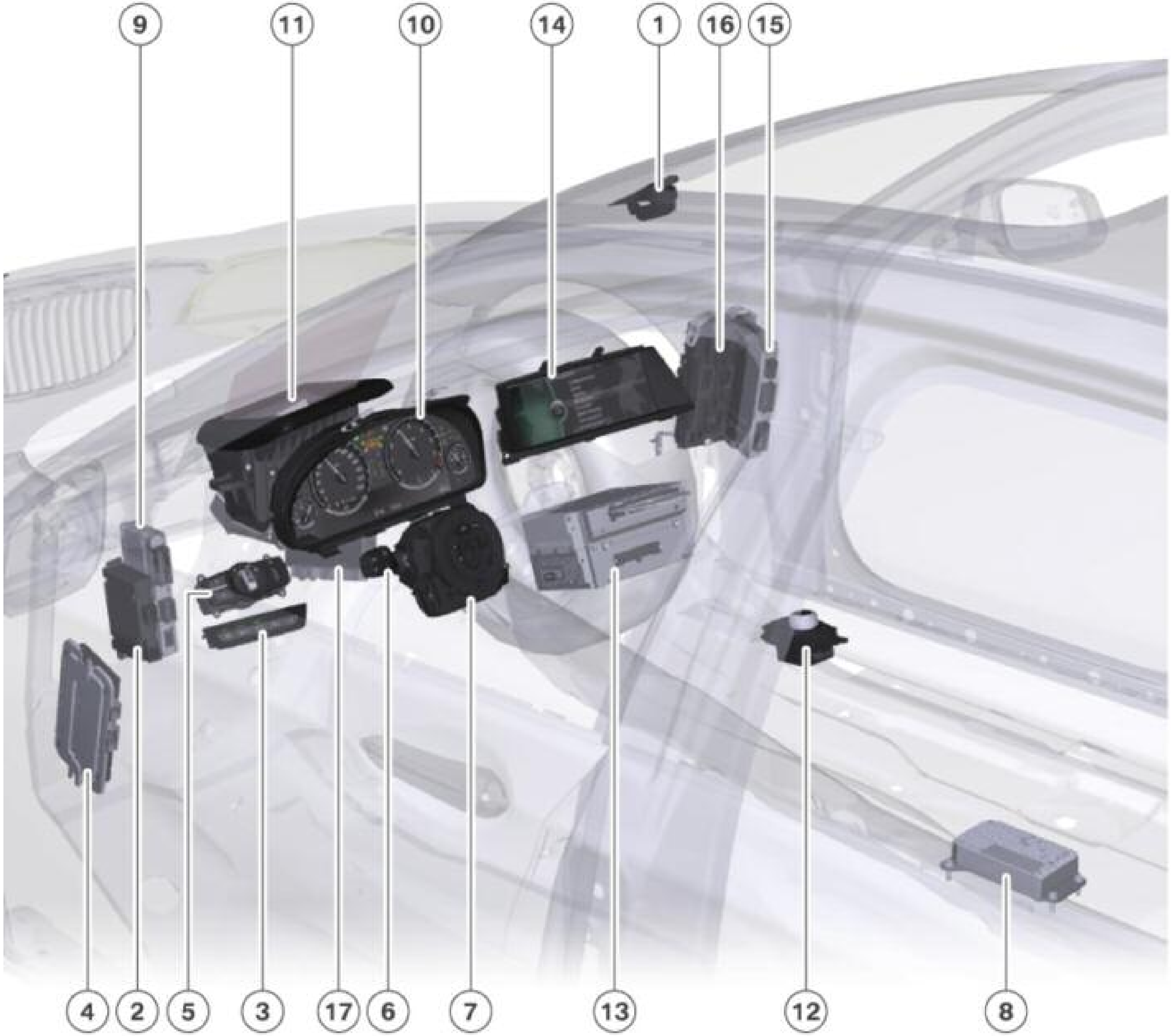
FLA (high beam assistant) is part of the ZDA Driver Assistance Package option and will not be available separately on the F01/F02

The ZDA Driver Assistance Package option includes the following:

- High Beam Assistant
- Lane Departure Warning
- Active Blind Spot Detection

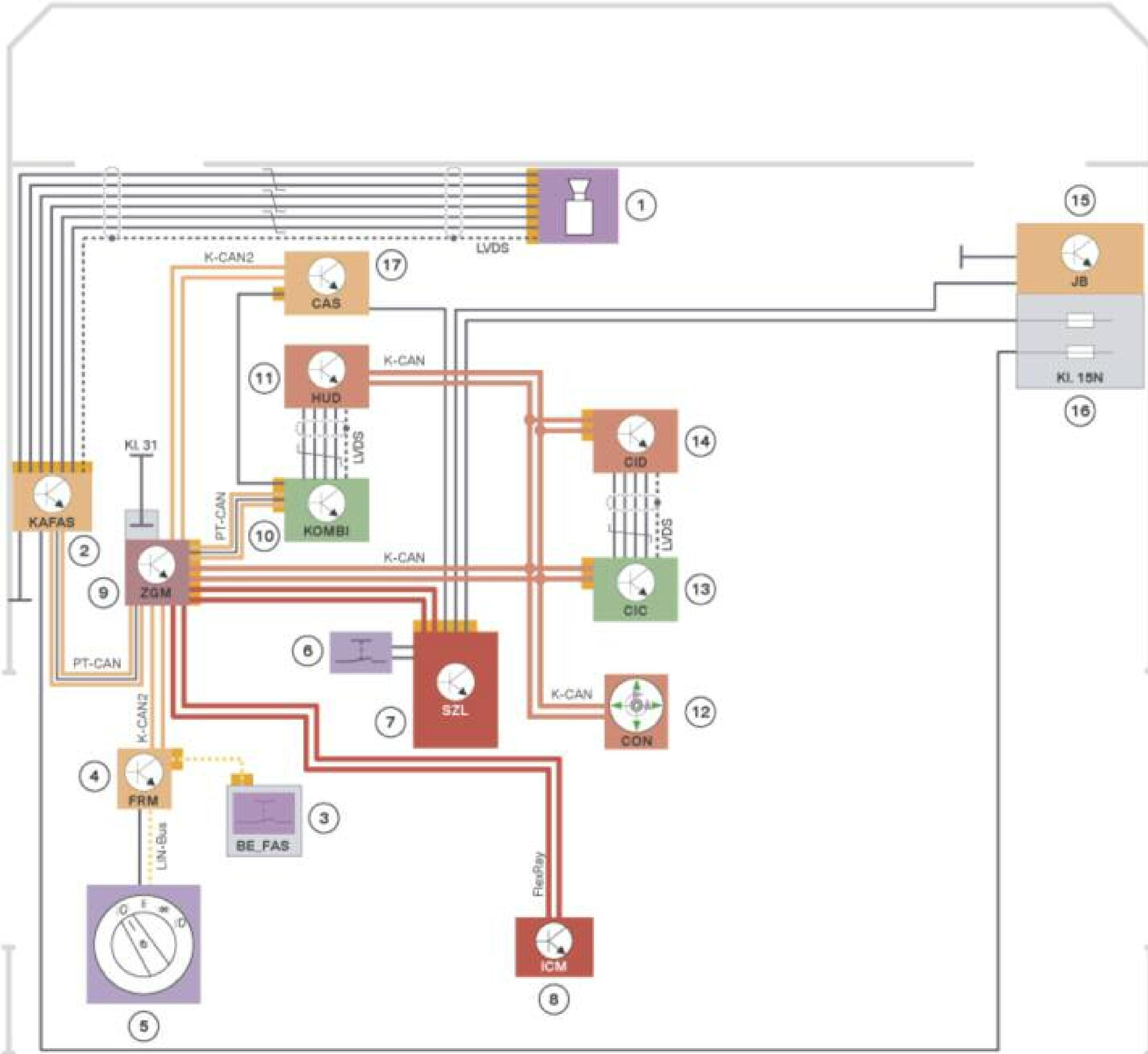
Options/Technical specification	
	KAFAS 1 camera 1 control unit 2 functions
Lane departure warning	X
High-beam assistant	X

System Components



Index	Explanation	Index	Explanation
1	Lane departure warning/High Beam Assistant forward-pointing video camera	10	Instrument cluster Function display
2	KAFAS control unit for evaluation of image data	11	Head-up display HUD Function display
3	Driver assistance systems operating unit Lane Departure Warning on/off button	12	Controller
4	Footwell module FRM Main-beam headlights on/off	13	Car Information Computer CIC navigation system, navigation system data
5	Light switch High-Beam Assistant function in position A or position II	14	Central Information Display CID
6	High-beam assistant on/off button on the turn signal stalk on the steering column	15	Junction box electronics
7	Steering column switch cluster SZL with turn signal stalk on the steering column	16	Front distribution box
8	Integrated Chassis Management ICM Road-speed signal	17	Car Access System CAS
9	Central gateway module ZGM		

Circuit Diagram



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9	Central gateway module ZGM		

Lane Departure Warning

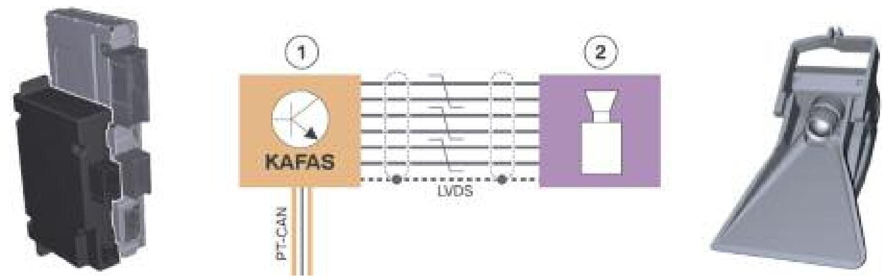
In the F01/F02, a video camera for the lane departure warning and the corresponding button in the BEFAS control panel for activating the lane departure warning system mean that the vehicle is equipped with the lane departure warning.

Video camera for lane departure warning and high beam assistant

The image data recorded by the video camera are transmitted to the KAFAS control unit along an LVDS data line.

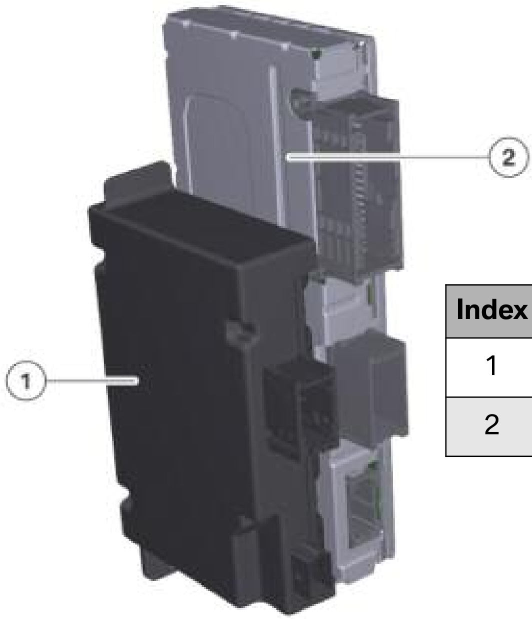
Although the video camera and the KAFAS control unit are the components that are fundamental to the lane departure warning's range of functions, they are also used for the headlight assistant

KAFAS control unit and video camera in the F01/F02



Index	Explanation	Index	Explanation
1	KAFAS control unit with PT-CAN	2	Video camera for lane departure warning and high-beam assistant. The image data sent from the video camera to the KAFAS control unit along the LVDS data line

KAFAS Control Unit



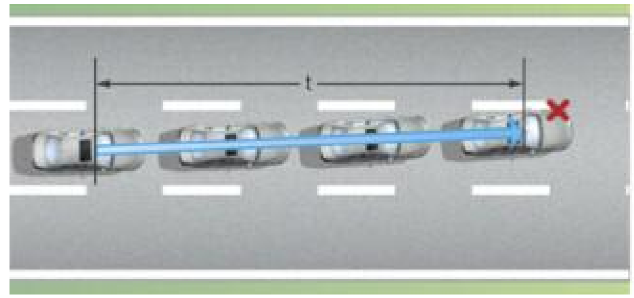
Index	Explanation
1	KAFAS control unit Driver's footwell
2	Central gateway module ZGM

The KAFAS control module is located in the left footwell area, bolted to the ZGM.

The lane departure warning causes the steering wheel to vibrate to warn the driver that the vehicle is threatening to leave the current lane without driver intending it to do so. The prerequisite for this function to work is the presence of road or lane markings that can be recognized by the control unit based on an evaluation of the images recorded by the forward-pointing video camera.

The system is therefore intended to assist the driver in case of a lapse of attention. Nevertheless, the driver continues to bear full responsibility for the vehicle.

The system is designed to assist the driver on highways, major roads and well maintained country roads. Warnings are given, therefore, only at speeds of over 44 mph.



F01/F02 Lane departure warning

The driver activates the system using the lane departure warning button in the driver assistance control panel.

Driver assistance systems control panel in the F01/ F02

Lane departure warning switched on

Lane departure warning ready

Warning

The system uses the same vibrating actuator as in Active Blind Spot Detection to issue the lane departure warning.

The active system is ready whenever the prerequisites for a lane departure warning have been fulfilled: Lane detected and V > 40 mph.

If the vehicle threatens to drive over the lane marking, the system warns the driver by causing the steering wheel to vibrate.

Based on the detection of one or two lanes, the system first calculates the position of the vehicle in relation to these lanes.

Using the vehicle's steering angle and road speed, the system calculates the time (t) remaining before the vehicle would cross the lane marking.

The warning is output in time before the vehicle crosses the marking.

Index	Explanation	Index	Explanation
1	Steering wheel electronics	2	Vibration actuator for the lane departure warning

High Beam Assistant

The high-beam assistant (FLA) assists the customer in the use of the high-beam headlights. Depending on the traffic situation, the prevailing ambient light conditions and which lights on the vehicle have been switched on, the FLA switches on the high-beam headlights automatically and thereby relieves the customer of having to switch the high-beam headlights on manually.

High beam can still be switched on and off manually as usual. The driver always has the capability, and indeed the obligation, to override the system whenever the situation requires it.

High-beam assistant display and button

Index	Explanation	Index	Explanation
1	Steering column stalk	3	Display when high-beam assistant activated
2	High-beam assistant button	4	Display when high-beam headlights on

Evaluation of Image Data

The various dots, colors and intensities of light captured by the camera are evaluated by the control unit and, based on the control unit's assessment, a switch-on or switch-off recommendation is sent from the KAFAS control unit to the footwell module.

In addition to the switch-on/switch-off recommendation, road speed is also taken into account.

At speeds below 24mph, the FLA is switched off; at speeds higher than 31mph, it may be switched on, depending on all other parameters.

If the vehicle is in an environment with adequate light, the high-beam headlights do not switch on. The KAFAS control unit sends a switch-off recommendation to the footwell module.

These conditions could be:

- Daylight
- Twilight
- Road lighting
- Illuminated places.

The system is designed to switch off the high-beam headlights automatically in response to the following conditions.

- Oncoming traffic
- Preceding traffic
- Detection of background brightness (twilight, street lamps, illuminated places, etc.)
- Driving speed too low.

Control of the Main-beam Headlights

At the request of the KAFAS control unit, the actual switching on and off of the high-beam headlights is always carried out by the footwell module, which is responsible for all of the exterior lighting.

The decision of the FRM to activate the dipped-beam headlights in "A" mode is made in the FRM independently of the FLA function. The FRM receives the light signal from the RLSS.

System Limitations

In various situations, and under specific environmental conditions, the limitations of a camera-based system begin to impact on functionality.

These limitations may be reached in the following situations.

- Extremely bad weather conditions (e.g. fog or heavy snowfall)
- Poorly illuminated road users (e.g. riders on small motorcycles, cyclists, pedestrians)
- Individual driving situations (e.g. sharp bends, steep hills, traffic coming at right angles from left or right)
- Differentiation between different light sources, reflective traffic signs, etc.
- No recognition of oncoming traffic is possible if only the cone of light is within the video camera's field of view.

  Recognition is only possible if the light source itself is within the field of view of the video camera.

The driver is able to intervene at any time and override the assistance system by switching the high-beam headlights on and off manually.

The driver always bears sole responsibility for the vehicle and the control of the vehicle's lighting.

Service Information

Lane Departure Warning

The lane departure warning has been available:

- Since 03/07 in the
  - E60
  - E61 and
- Since 09/07 in the
  - E63
  - E64

In the event of a replacement of components, the instructions for the necessary coding and calibration routines stored in the diagnostics and programming system must be observed.

You will also find information on the lane departure warning in the “E60/E61 Lane departure warning” training material” available on TIS and ICP.

High Beam Assistant

The high beam assistant was introduced for the first time in the E60, E61, E63 LCI, E64 LCI BMW models from 2007 Model Year.

The high-beam assistant is not available separately for the F01/F02 and is part of the ZDA Driver Assistance Package option.

Low-sensitivity Mode

A low-sensitivity mode has been implemented in order to comply with the US requirements. In this mode, the sensors are less sensitive.

To activate this mode, the driver must press the turn signal stalk on the steering column forwards for 10 s with the vehicle stationary, the lights switched off and terminal 15 ON.

As soon as the high-beam assistant is activated, the driver receives a Check Control message indicating that low-sensitivity mode is active.

The high-beam assistant reverts to its basic state following a power cycle.

Check Control Indicator

The Check Control may display messages under the conditions described below.

Cause	Condition	Sending unit
Hardware/software defect	"Internal fault"	FLA or footwell module
Sensor field covered	FLA detects covered windshield	FLA

Check Control message	Condition	Information in Central Information Display
	High-beam assistant not active	High-beam assistant High beam assistant not active. Sensor field covered. Manual activation and deactivation of high-beam
	High-beam assistant defective	High-beam assistant high beam assistant defective. Have the system checked by the nearest BMW Service
	Sensitivity adjusted	High-beam assistant Sensitivity adjusted for automatic high-beam headlights. Possible risk of dazzling oncoming vehicles

NOTES PAGE

Classroom Exercise - Review Questions

1. Where is the FLA module located in the F01/F02?

2. Where is the KAFAS control unit located?

3. What is included in the in the ZDA Driver assistance Package Option?

4. What input does the ICM supply to the KAFAS control unit?

5. Which control module controls the headlights, in the FLA system?

PDC-TRSVC

Park Distance Control (PDC) is standard equipment on the F01/F02 with the ZCE Camera Package available as an option. The Camera Package includes the Rear-view camera (3AG) and the Side View Camera (5DK)

Park Distance Control

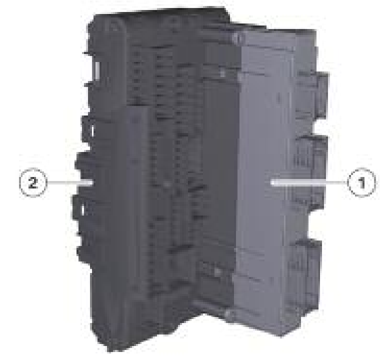
The Park Distance Control of the F01/F02 is identifiable by the five ultrasonic sensors on the front bumper. The fifth sensor enables a high level of reliability in obstacle recognition to be achieved despite the large front end of the F01.

F01 front bumper with five Park Distance Control ultrasonic sensors

Note: During installation of the license plates, caution must be taken not to cover the center sensor on the bumper.

In the F01, the PDC control unit function has been integrated into the junction box electronics for the first time.

Index	Explanation
1	Junction box electronics with integrated PDC control unit
2	Front distribution box



Rear View Camera Location

In the F01, the optional rear view camera requires the vehicle to have been equipped with the PDC option. The rear view camera is located at the right of the recessed handle on the luggage compartment lid.

Rear view camera location

Side View Camera

The F01/F02 is the first of BMW's vehicles to feature the new Side View Camera.

The function is realized by two digital cameras, one on the front right wheel housing and one on the front left wheel housing. They make it easier for the driver to pull into roads and junctions in which the driver's view to the side is obstructed.

Index	Explanation
1	Bumper, front wheel housing
2	Side View camera, left

The driver can activate the Side View cameras using a button in the control panel next to the gear selector lever.

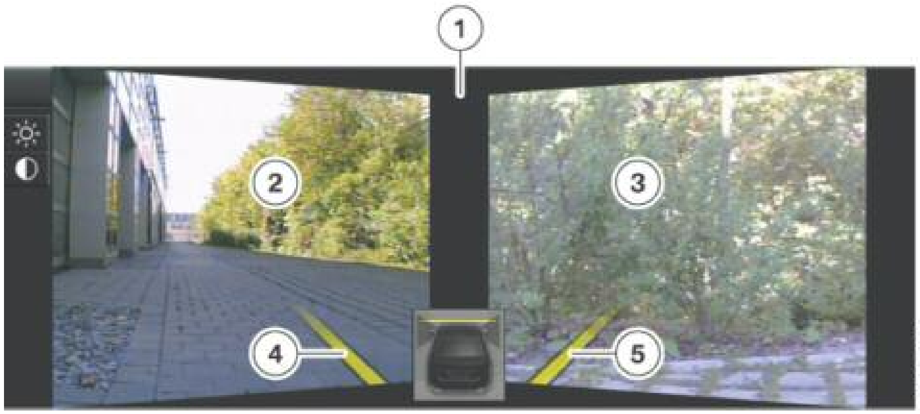
Index	Explanation
1	PDC and rear view camera on/off button
2	Side View button

The camera images are shown in the CID in split screen view up to a road speed of 30 km/h/19mph.

Like the rear view camera, the two Side View cameras send their signals to the TRSVC control unit along LVDS data lines.

The signals are forwarded along CVBS lines to the video switch VSW and CIC. The CIC sends image data to the CID along LVDS data lines.

The CID is where the image data are displayed.



Index	Explanation	Index	Explanation
1	Split screen images from the Side View cameras	4	Projected front of vehicle, view to left
2	Split screen images from the Side View camera on the left-side	5	Projected front of vehicle, view to right
3	Split screen images from the Side View camera on the right-side		

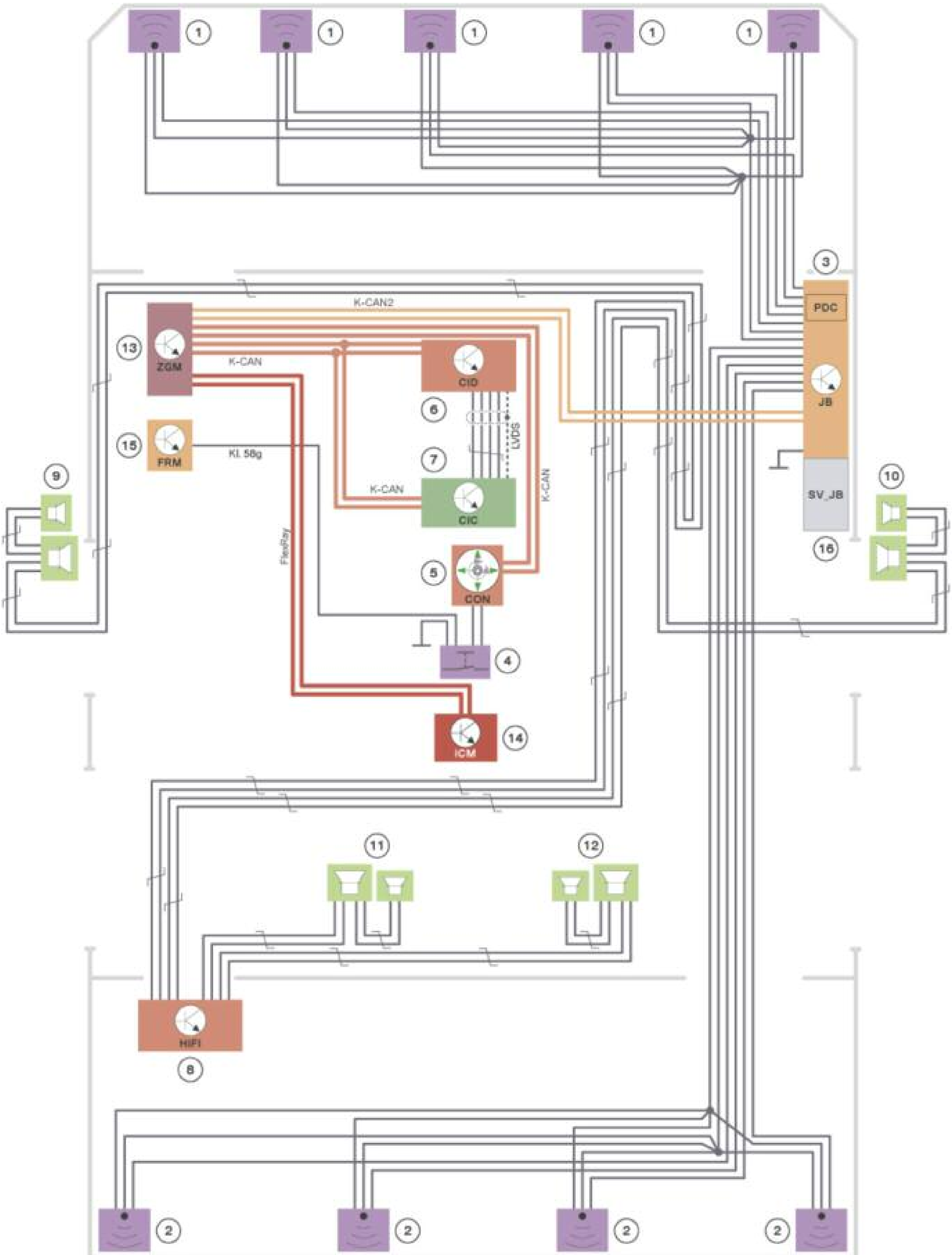
Rear View Camera

With the PDC and rear view camera equipment combination, the controller and the operating menu can be used to toggle between the basic PDC display and the rear view camera image with PDC.

Distance warning PDC display and option to select rear view camera image with PDC

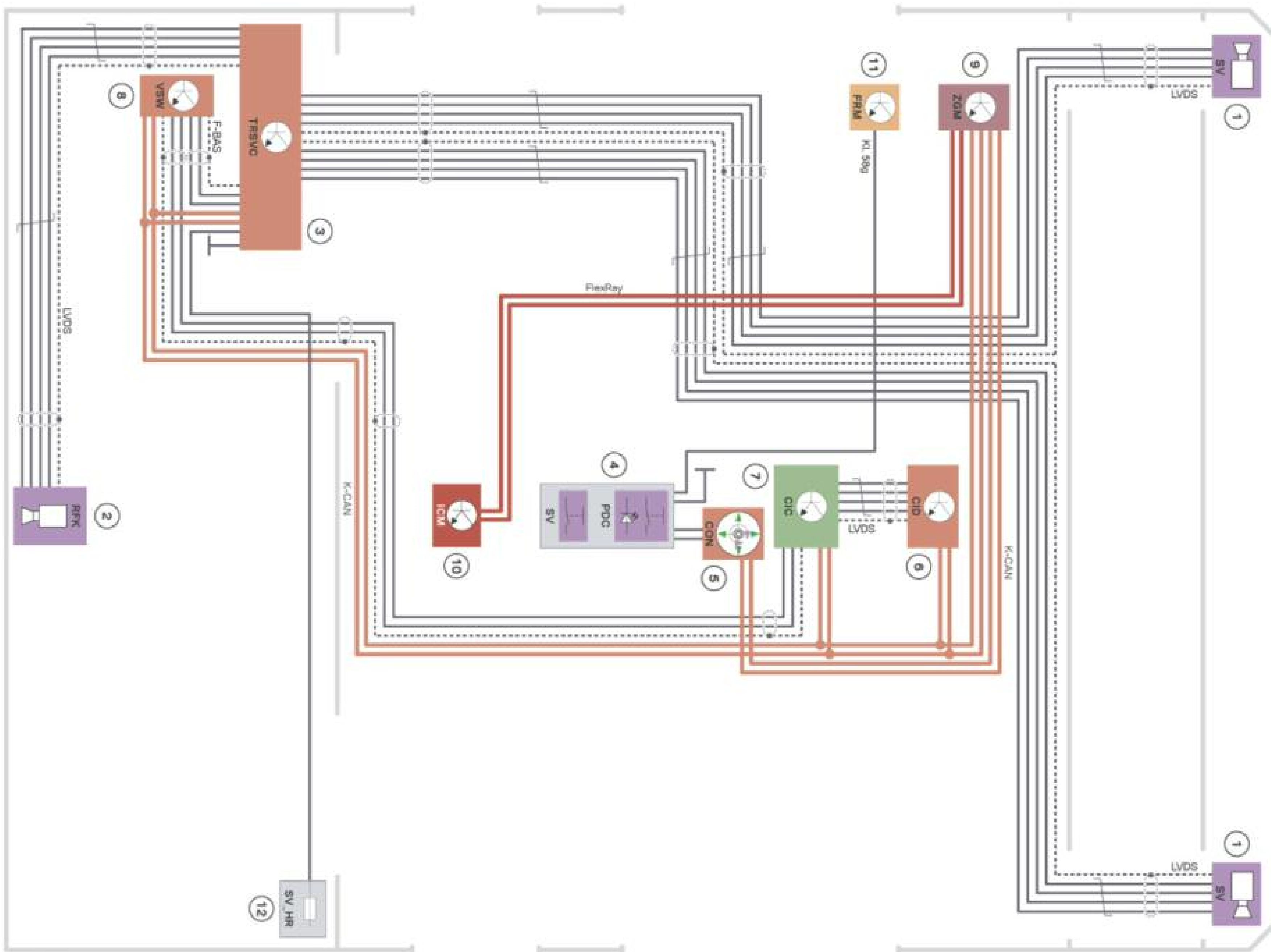
Index	Explanation	Index	Explanation
1	Distance warning PDC display with option to select rear view camera image	2	Rear view camera image and distance warning PDC

PDC system circuit diagram



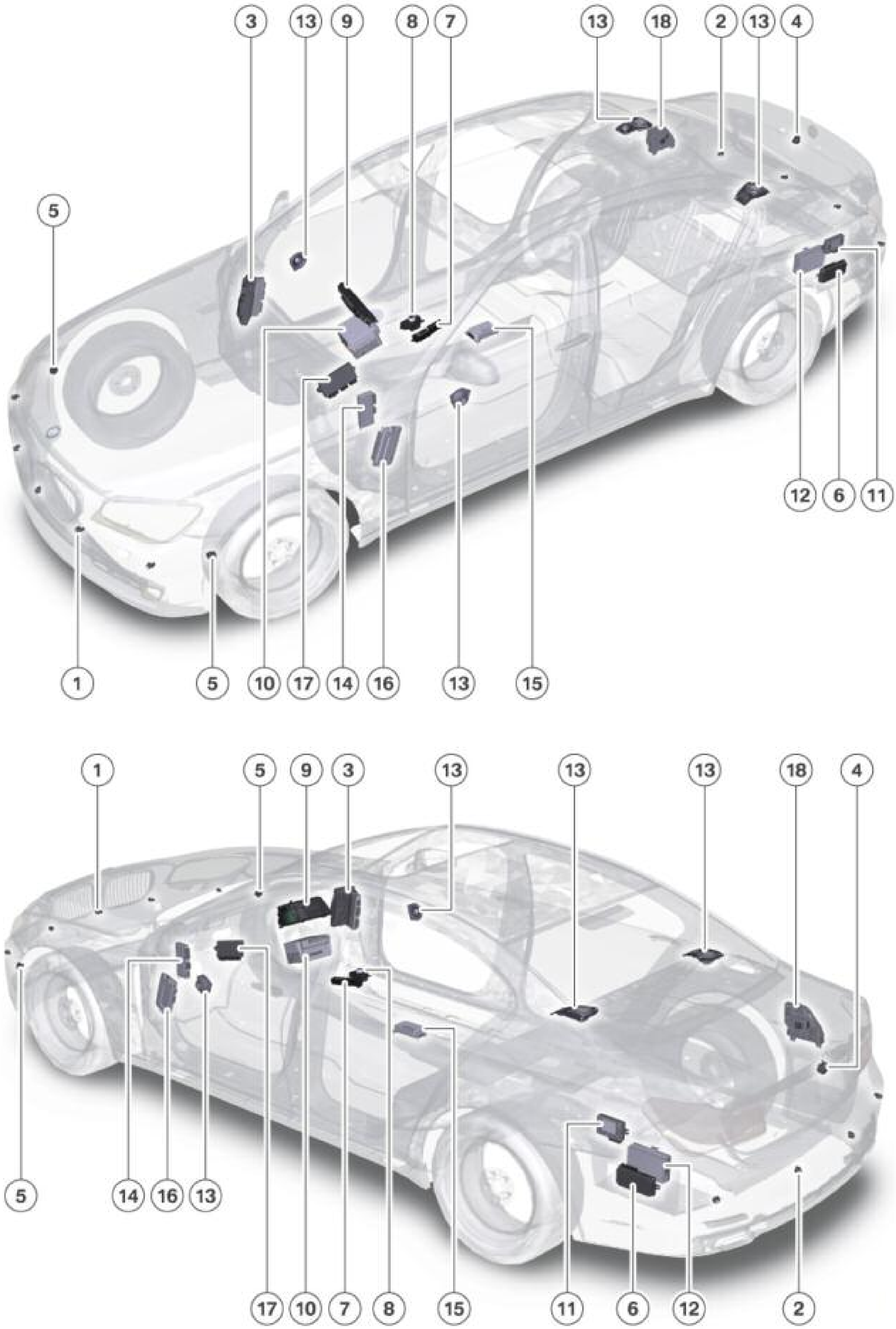
Index	Explanation	Index	Explanation
1	Five ultrasonic sensors in the front bumper	9	Loudspeaker, front left Audible distance warning (PDC)
2	Four ultrasonic sensors in the rear bumper	10	Loudspeaker, front right Audible distance warning (PDC)
3	Junction box electronics with integrated PDC control unit	11	Loudspeaker, rear left Audible distance warning (PDC)
4	PDC on/off button	12	Loudspeaker, rear right Audible distance warning (PDC)
5	Controller control unit with PDC on/ off button	13	Central gateway module (ZGM)
6	Central Information Display (CID) for PDC displays	14	Integrated Chassis Management (ICM) road-speed signal
7	Car Information Computer (CIC) data preparation for displays in the CID	15	Footwell module
8	Audio amplifier (HiFi) Audible distance warning (PDC)	16	Junction box electronics, front distribution box

System circuit diagram for rear view and side view camera



Index	Explanation	Index	Explanation
1	Side View cameras, left/right	7	Car Information Computer (CIC), data preparation for displays in the CID
2	Rear view camera	8	Video switch (VSW)
3	TRSVC control unit	9	Central gateway module (ZGM)
4	PDC on/off button and Side View on/off button	10	Integrated Chassis Management (ICM), road-speed signal
5	Controller - Control unit for PDC/rear view camera on/off button and side view on/off button	11	Footwell module (FRM)
6	Central Information Display (CID), for displays of PDC/rear view camera/side view	12	Distribution box, luggage compartment

Workshop Exercise - System Components



Index	Explanation	Index	Explanation
1		10	
2		11	
3		12	
4		13	
5		14	
6		15	
7		16	
8		17	
9		18	

Classroom Exercise - Review Questions

1. What must be kept in mind while mounting license plates in a F01/F02?

2. How many PDC sensors in total are installed on the F01/F02?

3. What is the road speed that the side view camera stop working?

4. Where are the side view camera located?

5. Where is the PDC control unit located?

Diagnostics Master

The Diagnostics Master function is a function distributed throughout the vehicle. It is divided into the following subfunctions:

- Time Master
  Includes the centralized specification of a system time for all control units in the vehicle, and the application as a time stamp for fault messages from control units.
- Centralized fault memory
  Includes the saving of fault and Check Control messages with centralized ambient conditions.
- Specification of the fault memory status
  Includes the centralized specification a fault memory block for network fault memory entries in specific situations as well as the evaluation/application of the block in the client control units.

One task is often divided over multiple computers in a computer network (this also includes control units with bus connections). It is important to specify the computer (or control unit) that has the main function. This control unit is then described as the main control unit or "master". All other computers (control units) are called “peripherals” or "secondary controllers".

Each subfunction of the diagnostics master includes a master portion and a secondary portion. The master portion is always implemented in a single control unit, but the secondary controller portion in all participating control units.

Subfunction	Master
Time master	KOMBI
Centralized storage of fault messages	ZGM
Specification of the fault memory status	Junction Box

Time Master

The Time Master is located in the instrument panel and cyclically transmits the system time to all other control units in the vehicle every second.

This system time is set to zero only once in the life cycle of the vehicle while in the factory at the end of the production process. The system time expresses the time in seconds that have passed since initialization in the factory.

The counter for the system time is not reset when the battery is disconnected or when the power to the instrument panel is switched off.

When the battery is disconnected the time value is actually initially lost, but it is updated when the power supply is again available. This is achieved by reading the last value stored in the non-volatile memory (EEPROM), increasing it by one time unit, and applying it in the Time Master as a new system time. The counter for the system time can map a time of approximately 136 years.

The system time is received by all control units, and used it as a time stamp when fault messages are stored.

To allow retention of the system time even after replacement of the instrument panel, it is stored redundantly in the CAS similar to the mileage reading.

Centralized Fault Memory

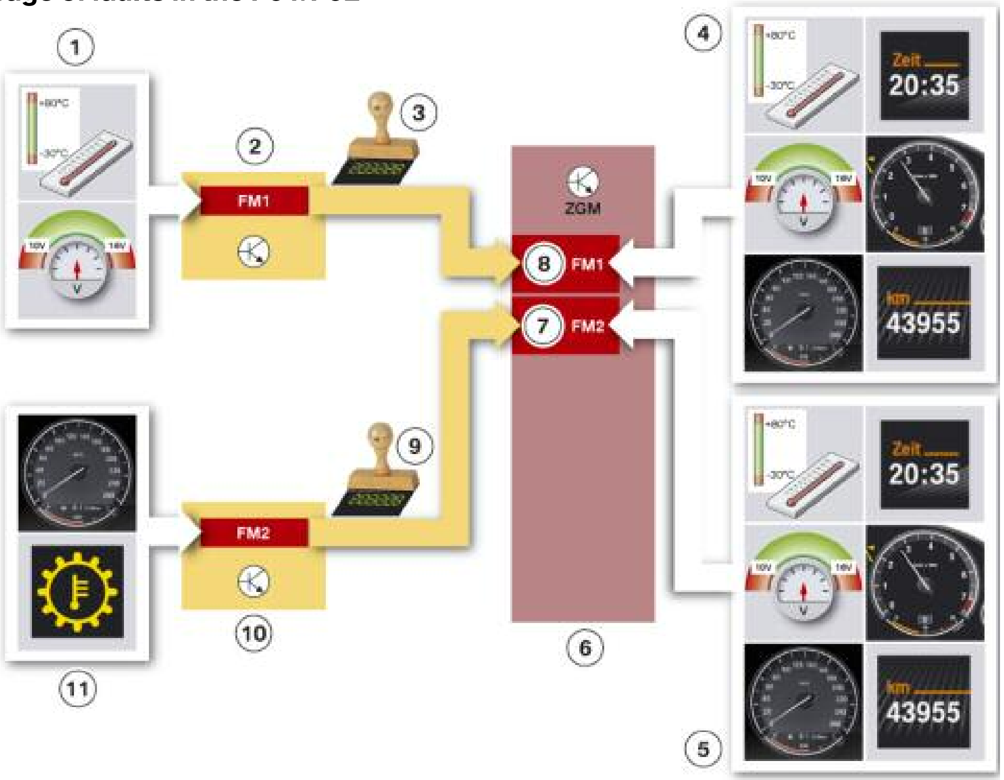
This subfunction has the task of centralized storage of fault and Check Control messages in addition to the local fault memories for each of the control units and the storage of CC messages in the instrument panel. The central gateway module (ZGM) is the master for this function and it is also called the Diagnostics Master.

Whenever faults occur, all control units locally save the fault along with at least the two mandatory environmental conditions of kilometer reading and system time. A new function is that the control units additionally signal the fault code and the system time at which the fault occurred (time stamp) to the Diagnostics Master (ZGM).

The fault memory concept and fault memory process of the control units have not been changed by the additional reporting to the Diagnostics Master. This means a control unit "very normally" makes a self-defined fault memory entry. The local fault memory entry remains untouched in the local fault memory of the secondary control unit.

The Diagnostics Master then additionally centrally stores the fault code and a fixed set of 26 ambient conditions at the same time that it indicated in the time stamp.

Storage of faults in the F01/F02



Index	Explanation	Index	Explanation
1	Two local ambient conditions for fault 1	7	Fault message 2 (FM2)
2	Fault 1 and 2 local ambient conditions are stored in the fault memory of the control unit	8	Fault message 1 (FM1)
3	Fault message 1 (FM1) and the "time stamp" are sent to the Diagnostics Master	9	Fault message 2 (FM2) and the "time stamp" are sent to the Diagnostics Master
4	Central ambient conditions at the time when fault 1 occurred	10	Fault 2 and 2 local ambient conditions are stored in the fault memory of the control unit
5	Ambient conditions at the time when fault 2 occurred	11	Two local ambient conditions for fault
6	Diagnostics Master in the ZGM		

The ambient conditions stored on the fault message by the Diagnostics Master include different information on the global status of the vehicle such as the:

- Standard time (year, month, day, hour, minute and second)
- Terminal status
- Vehicle system voltage
- Kilometer reading
- Outside temperature
- Vehicle driving speed.

The central fault memory in the ZGM has a size of 18 kB. Between 250 and 1000 fault events and Check Control messages can be stored centrally in the ZGM dependent upon how many faults occur simultaneously. When the fault memory is full no new faults or Check Control messages are stored. The fault and Check Control messages in the central fault memory can then only be deleted via the BMW diagnostic system.

Each fault code and each Check Control message is accepted up to 10 times. Without this limit, a constantly occurring fault would very quickly fill the entire central fault memory.

These ten entries are sufficient for analysis of the fault.

All central fault memory entries are lost when the ZGM is replaced.

Note: Primary fault analysis continues to be performed by using the fault memory entries in each of the control units. The data from the central fault memory of the Diagnostics Master serve to supplement and allow a more precise diagnosis. Functions for using this data are integrated in the new workshop system.

Advantages:

Previously (without Diagnostics Master), only the kilometer reading and system time (mandatory environmental conditions) and possibly a few additional ambient conditions could be found in the local fault memories.

The ZGM stores 26 additional ambient data items for each fault memory entry from each of the control units.

Additionally, up to 10 time instances at which the fault occurred are recorded in the ZGM for a fault code.

The time stamp with second-precision permits a statement upon the time sequence of fault events, which was previously not possible based solely upon the kilometer reading. For the first time it is possible to the name the cause and effect with greater clarity for distributed functions, e.g. the control unit that firstly entered a fault, the control unit that in consequence only entered a fault as a reaction, etc.

The Check Control messages at the time of the fault are also stored in the Diagnostics Master and are also provided with the 26 ambient conditions. "Customer complaints" can be assigned better to a vehicle situation because of the Check Control messages and above all also corresponding fault memory entries.

These measures have made a more precise diagnosis possible.

Note: Up to 55 fault codes (also without time stamp or ambient conditions as is currently the case) can still be stored In the CAS and in the identification sensor of the F01/F02.

Specification of the Fault Memory Status (pseudo fault reduction)

In certain vehicle operating situations invalid fault memory entries (pseudo faults) are made as the control units do not behave synchronously in these situations. The critical operating situations occur during:

- Wake-up of the vehicle
- Start of the combustion engine
- Under/Overvoltage.

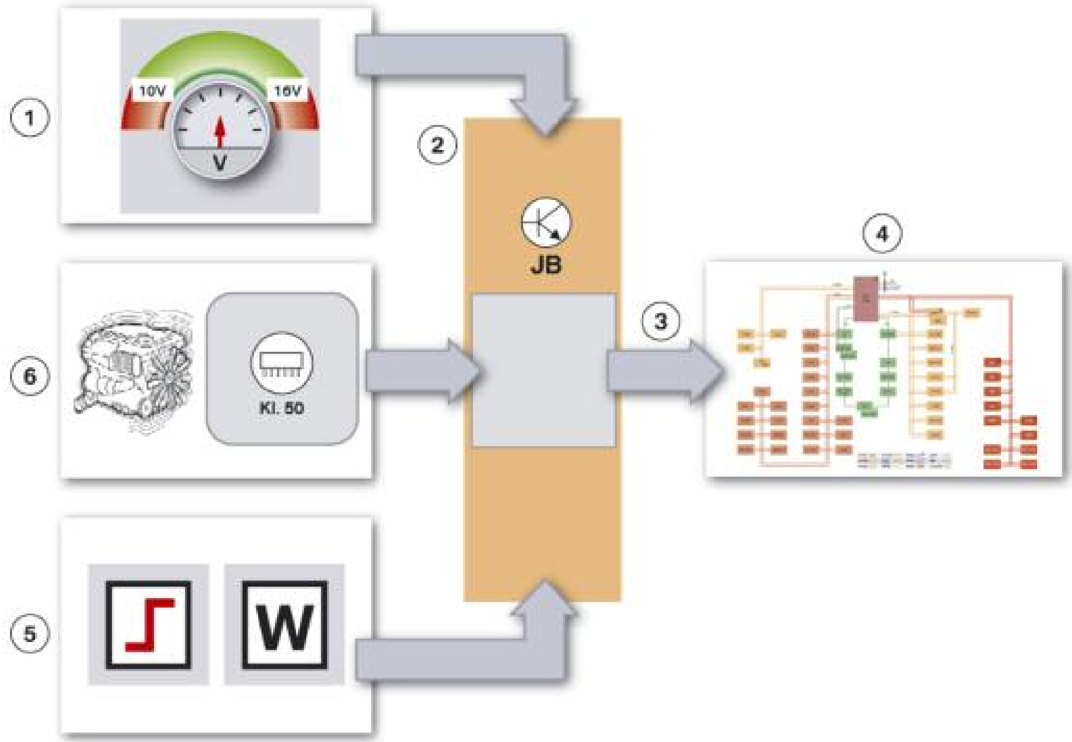
To prevent pseudo faults in these operating situations, a centrally communicated signal forbids specific faults from being entered in the local fault memories of the control units.

These will simultaneously actively prevent these faults being signalled to the master of the "storage system context" function and from being entered in the central fault memory.

The fault memory block is not only effective for network fault memory entries, however not for control units-fault memory entries.

The fault memory entries for control units relevant for exhaust gas and safety are not affected by this function and they will always be written.

Saving of faults is prevented under certain circumstances



Index	Explanation
1	Under/Overvoltage block condition: 10.5 V < U < 16 V Unblock condition: U > 11 V or U < 15.5 V
2	Junction Box (master for the subfunction specification of fault memory status)
3	Bus message "status - block fault memory"
4	All control units
5	Wake-up of the vehicle Block condition: wake-up signal Unblock condition: three seconds after wake-up signal tw > 3 s
6	Engine start (Terminal 50) block condition: Terminal 50 active

Vehicle Status Management

Vehicle status management is a system function with the task of implementing standardized system behavior in different operating conditions for all future BMW vehicles.

For instance, the different switch-on behavior of the radio. To switch on the radio in the E65, the START-STOP button must be pressed (Terminal R is switched on). In the E90, on the other hand, the radio can also be switched on without inserting the key's remote control into the insertion slot.

The vehicle status management system calculates a single vehicle status from the terminal status, vehicle movement, battery condition and status of the combustion engine. This status is then used to define when a customer function or a group of customer functions (e.g. all entertainment functions) has to be available.

Furthermore, the vehicle status management system controls the operating mode the vehicle or specific modules are in. Those functions that are to be available in a mode are controlled. *example*: No radio operation while in the transportation mode.

Distinction is drawn between the following operating states:

- Standby
- Basic control mode
- Ready to drive
- Engine start
- Driving.

A further vehicle status management task is the simultaneous start up and shut down of the on-board communication network.

F01 on the production line

Start up and shut down of the onboard communication network

The vehicle status management system describes the start up and shut down of the onboard communication network. In addition to general requirements, that are binding for all control units, the cascading, wake-up and sleep memories are defined.

Cascading

The cascading function ensures that all buses in the vehicle electrical and bus systems startup in coordination and shut down or "sleep" simultaneously. This function is made possible by a master function of the central gateway module (ZGM) that specifies whether the vehicle electrical and bus systems may sleep. This master function controls the secondary control units, each of which is responsible for the start-up and sleep for one bus. Secondary controllers are located in the following control units:

- ZGM (for K-CAN, K-CAN2, PTCAN, FlexRay and MOST)
- DME (for the PT-CAN2)

Wake-up and Sleep Memory

In the event that the vehicle should not correctly wake-up or sleep, this often results in an increased power requirement for the complete vehicle, which may cause an empty battery and therefore a broken-down vehicle.

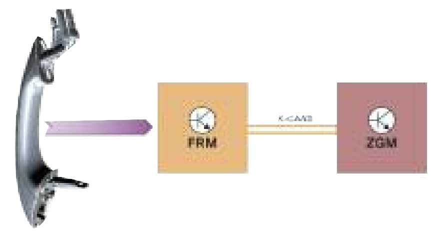
With the wake-up and sleep memory, the vehicle status management makes functions available for detection of faulty wake-up and sleep processes and initiation of countermeasures. For this purpose, the vehicle status management system has firstly recorded all possible reasons that could allow a control unit to wake-up the vehicle. When such a reason exists, the waking control unit must signal this reason to the wake-up and sleep memory that is contained in the ZGM.

Should a faulty wake-up exist, it is logged in the ZGM (fault memory entry that includes also the waking control unit and the wake-up reason as ambient conditions). The time and current kilometer reading are always saved as further ambient conditions. In this instance, the ZGM initiates countermeasures by transmitting the diagnostic command "powerdown". Should faulty wake-up events continue to occur after this, a reset of terminal 30F and then a permanent switch-off of terminal 30F is required. Just as with wake-up, faults may also occur for sleep. For such a fault, the wake-up and sleep memory creates a fault memory entry and initiates the same measures as for faulty wake-up.

All control units that may wake-up the vehicle are defined and assigned an identification number (hexadecimal number). Two seconds after each control unit has completed the wake-up process it transmits the bus message "wake-up registration FZM" to the ZGM and notifies the reason for the wake-up.

Example:

Wake-up by opening the driver's door FRM transmits the following message two seconds after the wake-up:

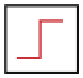


- Message ID: 0x5F2 (identification number for FRM)
- Byte 0: 0x27 (bus message "wake-up registration FZM")
- Byte 1: 0x72 (identification number FRM)
- Byte 2: 0x10 (Wake-up cause "door contact, front left")

Wake-up of the Vehicle

The bus overview of the F01/F02 with wake-authorized and wake-capable control units is shown below.

Wake-authorized control units may wake-up the vehicle electrical and bus systems.


The wake-authorized control units are shown on the bus diagram on the following page by a rising-edge symbol.

The wake-authorized control units include:

- K-CAN2: FRM, FZD, JB,
- K-CAN: IHKA
- MOST: RSE High, ULF-SBX High, ULFSBX and TCU

Wake-capable control units are woken up via a wake-up line.

W The wake-capable control units are identified with a "W". These control units are woken up via a wake-up line.

These include:

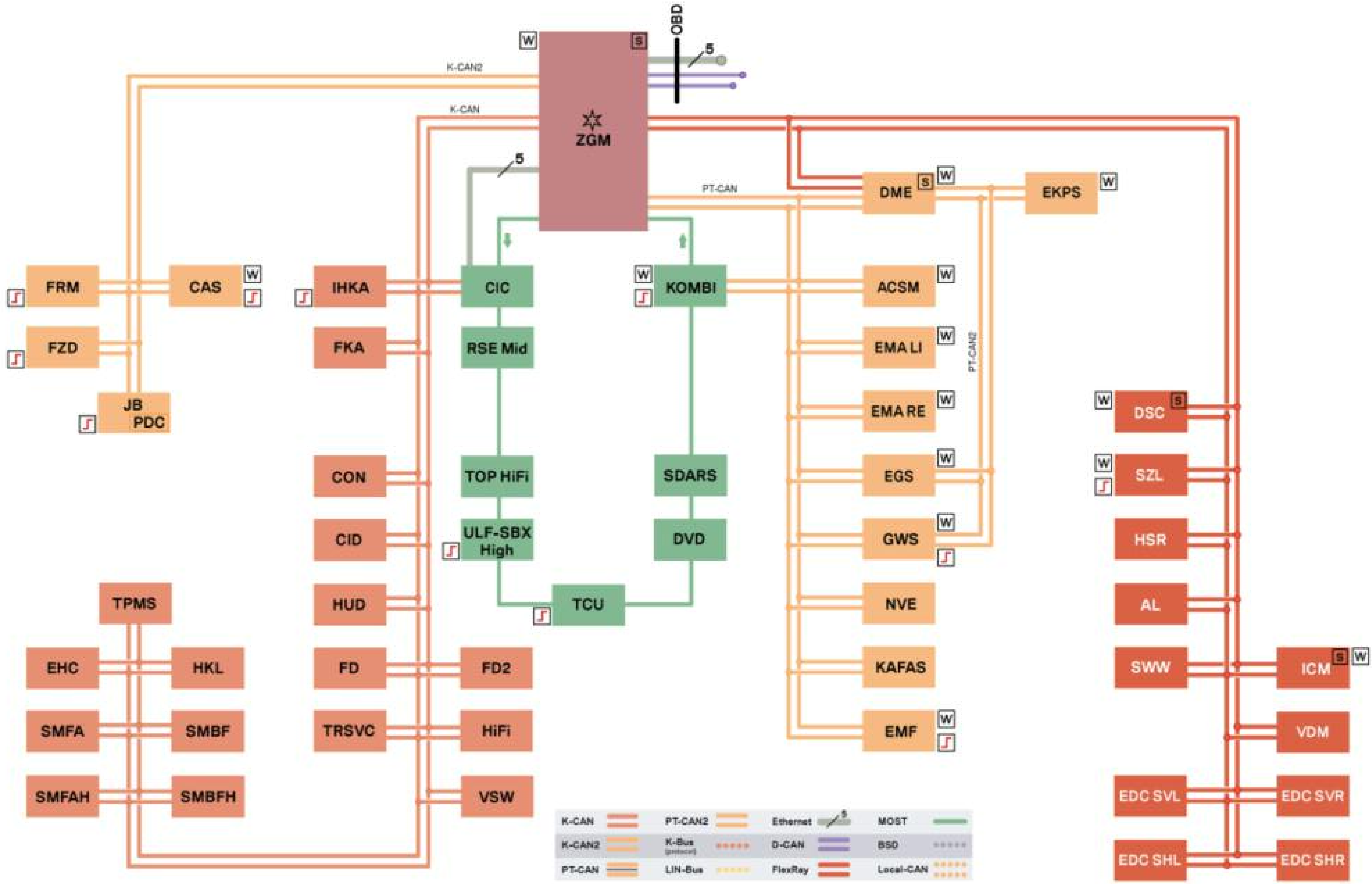
- ZGM
- PT-CAN: DME, ACSM, EMA LI, EMA RE, EGS
- FlexRay: DSC and ICM

Additionally, there is a group of control units that are “wake-authorized” as well as wake capable:

- K-CAN2: CAS
- MOST: Kombi
- PT-CAN: GWS and EMF
- FlexRay: SZL

The remaining control units are then woken up via the bus systems or via switching on the power supply.

Bus overview F01/F02 with wake-authorized/capable control units



Index	Explanation	Index	Explanation
ACSM	Advanced Crash Safety Module	EKPS	Electric Fuel Pump
AL	Active Steering	EMA LI	Electrically motorized reel, left
CAS	Car Access System (CAS 4)	EMA RE	Electrically motorized reel, right
CIC	Car Information Computer	EMF	Electromechanical Parking Brake
CID	Central Information Display	FD	Rear Display, left
CON	Controller	FD2	Rear Display 2, right
DME	Digital Motor Electronics	FKA	Rear compartment, heating/air conditioning
DSC	Dynamic Stability Control	FLA	High Beam Assistant
DVD	Digital Video Disc	FRM	Footwell Module
EDC SHL	Electronic Damping Control (Satellite rear left)	FZD	Roof Functions Center
EDC SHR	Electronic Damping Control (Satellite rear right)	GWS	Gear Selector Lever
EDC SVL	Electronic Damping Control (Satellite front left)	HiFi	HiFi Amplifier
EDC SVR	Electronic Damping Control (Satellite front right)	HKL	Trunk Lid lift
EGS	Electronic Transmission Control	HSR	Rear axle drift angle control (Rear Steering Control Module)
EHC	Electronic Height Control	HUD	Head-up Display

Index	Explanation	Index	Explanation
ICM	Integrated Chassis Management	SMFA	Seat module, driver
IHKA	Integrated Heating and Air Conditioning, automatic	SMFAH	Seat module, driver side rear
JB	Junction Box Electronics	SWW	Lane Change Warning (Active Blind Spot Detection)
KAFAS	Camera-assisted Driver Assistance Systems	SZL	Steering column switch cluster
KOMBI	Instrument Cluster	TCU	Telematics Control Unit
NVE	Night Vision Electronics	TOP-HIFI	TOP-HiFi Amplifier
PDC	Park Distance Control	TPMS	Tire Pressure Monitoring System
OBD	On Board Diagnostic Connector	TRSVC	Top Rear Side View Camera Module for rear/side view cam
RSE	Rear Seat Entertainment (Mid)	ULF-SBX High	Interface Box, high version
SDARS	Satellite Radio	VDM	Vertical Dynamics Management
SMBF	Seat module, passenger	VSW	Video Switch
SMBFH	Seat module, passenger rear	ZGM	Central Gateway Module

Calculation of the Vehicle Status and Control of Vehicle Functions

The vehicle status management system calculates a single vehicle status from the terminal status, vehicle movement, battery condition and status of the combustion engine. This status is then used to describe when a customer function or a group of customer functions (e.g. all entertainment functions) has to be available.

For instance, all functions for geometric adaptation are to be available in the basic control mode/stationary operation statuses. The operating states defined through vehicle status management are summarized in the following table:

Operating State	Identifying Feature	Function
Driving	Engine running	Active steering
Engine start	Starter motor running	Radio mute
Ready to drive	Engine OFF, driver present, ignition switched ON	This is where those functions are activated that are required for the driving mode, e.g. Park Distance Control, air-conditioning system, passive safety systems
Basic control mode	Engine OFF, driver present, ignition switched OFF	Radio, seat adjustment
Standby	Driver's absence identified by: • Secure vehicle, or • Non-initiation of driver interaction for 30 minutes.	Functions that have to exist when the driver is absent, e.g. DWA, CAS (read-in remote control)

Control of Operating Modes

Those functions that are to be available in an operating mode are defined (e.g. no radio operation in transportation mode) via the vehicle status management system. There are three operating modes: manufacture, transportation, flash, which are abbreviated in German as FeTraFla mode.

FeTraFla mode replaces the former manufacture, transportation, workshop or FeTraWe mode. Workshop mode has rarely been used to date and has been replaced by flash mode.

Flash mode offers the advantage that communication between the control units is reduced to a minimum during programming, and therefore higher data transfer rates are achieved from the BMW Programming system into the vehicle. Additionally, the control units are notified that programming is taking place.

This prevents the control units from going into emergency operation (e.g. the windscreen wiper does not start).

Flash mode is activated via a diagnostic command. The control units permanently save this mode. This has the advantage that the control units still know that they are in flash mode after a reset. In earlier vehicles a reset often had the consequence that a control unit had interrupted communication and this had consequently caused a flash termination.

It is also possible to use the "extended operating modes" to further subdivide a mode in order, for instance, to suppress or activate functions only at specific conveyor belt sections during manufacture.

Ethernet Access

The increasing number and complexity of functions in the vehicle cause a constantly increasing rise in the number of control units and consequently the data volume in the vehicle. When these data are to be updated the vehicles must be programmed over the BMW programming system. The number of BMW vehicles that can be programmed has constantly increased since the introduction of the E65 in 2001.

The challenge facing the Service Department is the programming of ever increasing data in increasing numbers of vehicles.

In order to accelerate the programming procedure in the workshop, an Ethernet access has been integrated in the diagnostic socket of the F01/F02 in addition to the OBD access (D-CAN).

It is Fast Ethernet compliant with IEE802.3 2005 100 base TX.

This standardized interface provides a centralized, standardized access in the vehicle. This access permits IP-based communication with the vehicle.

The vehicle is therefore uniquely identifiable as a communication partner in an IP-based network, and BMW diagnosis and programming systems can be used in the workshop for the data exchange with the vehicle.

Note: The previously used MOST direct access is not installed in the F01/F02.

What is Ethernet?

Ethernet is a cabled data network technology for local area networks (LANs). It facilitates the data exchange in the form of data frames between all devices (computers, printers, ...) connected in a local network (LAN). Earlier the LAN only extended over one building.

Today the Ethernet technology uses fiber glass or radio to also connect devices over long distances.

Ethernet was invented over 30 years ago. A protocol was used as a transmission protocol that was in use at that time for radio-based networks.

Consequently the name Ether, that had been assumed historically to be the medium for propagation of radio waves.

In an Ethernet network, the users in the common cable network transmit messages via high-frequency signals.

Each network user has a unique 48-bit key that is called the MAC address. This ensures that all systems in an Ethernet have different addresses.

MAC is an acronym for Media Access Control.

The MAC address is required because a commonly used medium (network) can not be used simultaneously by multiple computers without data collisions, and therefore communication faults or data losses occur in the short or long term.

Different data transfer speeds were defined during development of Ethernet. Since 1995 the 100 Mbits/s standard has been used and it is called Fast Ethernet.

In the F01/F02, Fast Ethernet compliant with standard IEEE 802.3 2005 100 base TX with 100 Mbits/s data transfer rate is used.

100 Mbit/s Ethernet is also used today as the LAN connection for PCs.

Ethernet connection for a PC

In addition to a higher data rate, the 100 Mbits/s Ethernet offers the following advantages:

- All BMW dealers have an Ethernet infrastructure
- Ethernet is future-proof
- Standard IT technologies can be used inside and outside of the vehicle
- Ethernet allows a cable length of 100 m (cable length today in the workshop = 10 m).

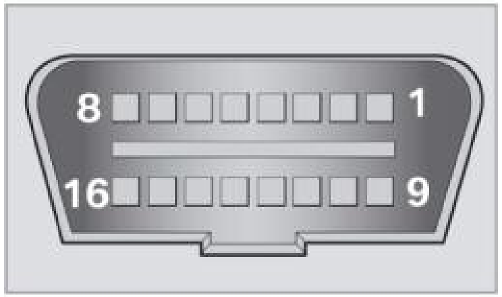
Ethernet Port

As there were enough free pins in the diagnostic socket it was possible to integrate the Ethernet port in this socket.

This installation location is the optimal solution for the vehicle access. The further advantage lies in that D-CAN as well as Ethernet can be connected to BMW diagnostic and programming systems via one connection (ICOM A).

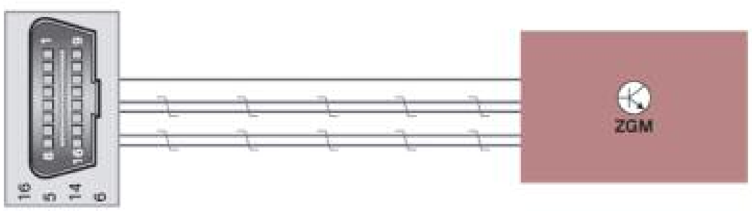
Five pins are used for the Ethernet port in the diagnostic socket.

Diagnostic socket



Index	Explanation	Index	Explanation
1	Not assigned	9	Engine speed
2	Not assigned	10	Not assigned
3	Ethernet Rx+	11	Ethernet Rx-
4	Terminal 31	12	Ethernet Tx+
5	Terminal 31	13	Ethernet Tx-
6	D-CAN High	14	D-CAN Low
7	Not assigned	15	Not assigned
8	Ethernet activation	16	Terminal 30F

Ethernet connection between the diagnostic socket and ZGM



These five lines are routed from the diagnostic socket to the central gateway module (ZGM).

One of the five lines transmits the activation signal. The remaining four lines are twisted pair and are used for data transmission.

Activation of the Ethernet Access

The Ethernet access is switched off in normal operation. It must be activated prior to every usage and then deactivated after it has been used.

Upon connection of the ICOM A, the activation line (Pin 8) is connected to terminal 30B (Pin 16) and this activates the Ethernet access.

The Ethernet module in the ZGM receives the signal (voltage level of terminal 30B) via the activation line. When the ICOM A is disconnected from the diagnostic socket the Ethernet access is deactivated. When the customer is in driving mode the Ethernet access is always deactivated.

Each user in an Ethernet is assigned an identification number that is unique throughout the world, the MAC address (Media Access Control). A user in a network is uniquely identifiable via the MAC address. The MAC address of the vehicle is located in the ZGM and can not be changed.

The VIN (Vehicle Identification Number) identifies the vehicle to the BMW programming system. Before communication with the vehicle can take place, just the same as for a computer network in the office it is necessary for each device in an IP-based network to have received a logical identification, called the IP address. The IP address is only unique in the respective network segment (subnetwork) and it can be assigned dynamically or statically.

After activation of the Ethernet connection and establishment of the physical connection the central gateway module is assigned the IP address from the ICOM A. Through a special process, the so-called "vehicle identification", the IP address, VIN and MAC are exchanged between the BMW diagnosis or programming systems and the ZGM. This allows unique identification of the vehicle in the workshop network and therefore a communication connection can also be established.

The function of an IP address in a network corresponds to a phone number in the telephone network. Assignment of this IP address is performed per DHCP (Dynamic Host Configuration Protocol). This is a process for automatic allocation of IP addresses to new end devices in a network. Merely the automatic reference to IP address must be set on the end device.

It must be possible to assign the IP address dynamically (DHCP server) for operation in a changing workshop network infrastructure.

The vehicle should adapt to the network and not the network to the vehicle. After disconnection of the ICOM A the assigned IP address is released upon expiry of the time set in the DHCP server.

Data enters into the vehicle and is distributed in the vehicle via the Ethernet access over the central gateway module.

The Ethernet connection does not have any effect upon the operation and time response of the D-CAN connection.

Note: Simultaneous operation of the D-CAN and Ethernet access must be prevented, as this makes collisions of diagnostics commands within the vehicle probable and therefore communication via both accesses can become faulty.

Vehicle Connection to the BMW Shop Network

An example of connection of the F01/F02 to the BMW workshop network is shown in the diagram below.

An IP address is automatically assigned to the vehicle after connection of the ICOM A. This allows unique identification of the vehicle (the ZGM) in the BMW workshop network, and a communication connection is established.

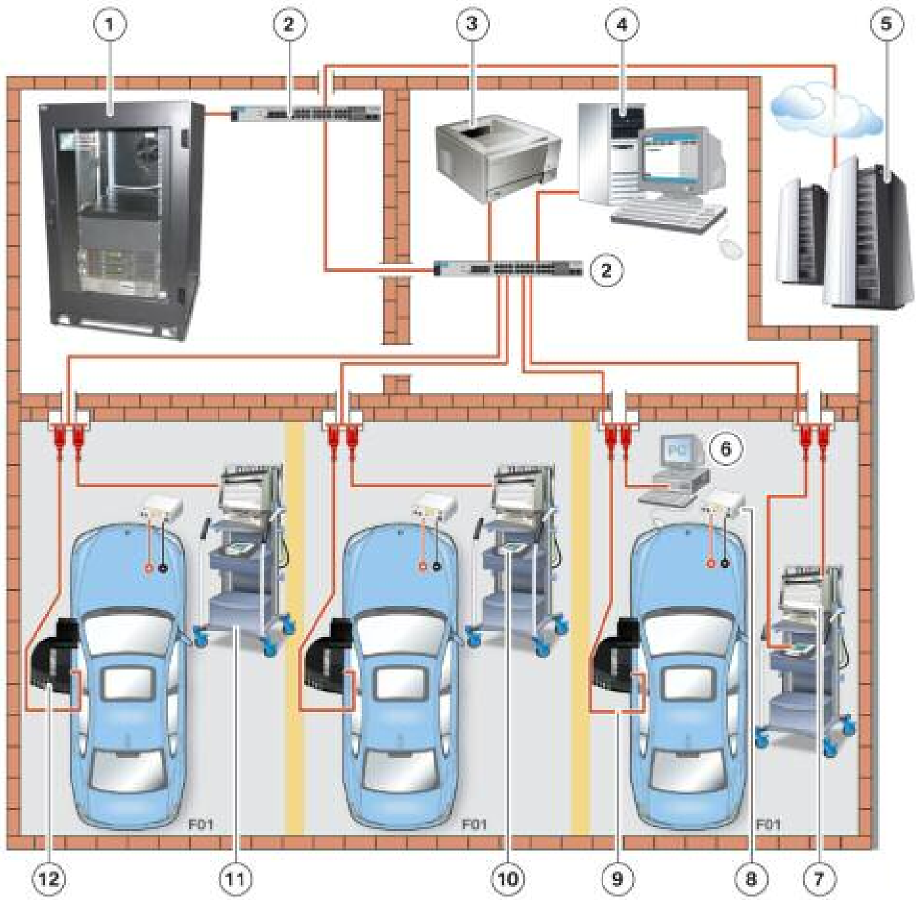
Authentication must be completed, and a signature is necessary for writing (programming) data into the vehicle. As opposed to this, it is possible to read (diagnosis) data immediately after a data line has been connected to the vehicle. The authentication and signature prevent third parties from changing data records and memory values.

Programming is carried out using the Software Service Station and ISTA-P.

The ICOM A must always be connected to the workshop network over LAN cable to allow programming to be carried out.

Programming is always performed over the Ethernet access. Only the diagnosis and no programming is performed over D-CAN.

The connection to the vehicle must be retained until programming has been fully completed. The ZGM assumes the gateway function and distributes data over the buses to the other control units.



Index	Explanation	Index	Explanation
1	Integrated Service Information Server ISIS1	7	Integrated Service Information Display ISID
2	Gigabit switch	8	Battery charger
3	Printer	9	LAN cable
4	Integrated Software Service Station ISSS	10	Integrated Measurement Interface Box IMIB
5	BMW Group server	11	Workshop trolley
6	Workshop PC	12	Integrated Communication Optical Module ICOM A

Definitions

Authentication

Authentic from the Greek work "authentikos" = valid, real, credible.

Authentication = confirmation of authenticity

To authenticate = to make valid, make credible.

Nowadays the conformation of authenticity is often stated in connection with rights of use e.g. for PCs or access to buildings.

Authentification

The process of proving the identity (authenticity) upon request.

For instance, check of the user password by the PC system.

To avoid confusing authentification, authentication and authorization, the following example:

A user wants to log on to his PC. He authenticates himself.

The PC system wants to check whether the user is entitled to log on to the system: It authentifies.

After it has completed the check, the PC grants access: It authorizes the user.

Digital Signature

= Digital acceptance

From the Latin "Signum" the sign.

A digital signature in an encryption procedure with the purpose of ensuring the trustworthiness of a person.

In this case, the authorship and affiliation of data to a specific person is checked.

Simultaneously the completeness, genuineness and intactness of the signed electronic data are checked.

Vehicle Configuration Management

The vehicle configuration management system (VCM) is a system function and has the primary task of centralized storage of data structures in the vehicle. The VCM integrated in the central gateway module ZGM as a system function.

The vehicle order and the I-levels in addition to the security are stored in the CAS. This ensures that the information can be restored after the ZGM has been replaced. The information stored in the vehicle configuration management system can be called by diagnostic commands upon request from the diagnosis system or internal vehicle system functions.

This means that the current vehicle configuration is saved centrally at precisely one place and a consistent information status is assured. This configuration knowledge only needs to be maintained at only one place. As this information is stored in the vehicle it is available at all times to all systems outside of the vehicle (diagnosis, programming) and the systems inside of the vehicle (system functions).

A further primary task of the vehicle configuration management system is the query, cyclic or upon request, of the configuration of the currently installed control units, and to use this to generate an equipment installation table that represents the current status, SVT-current. A comparison between SVT-nominal and SVT-current then takes place in order to determine whether the configuration installed in the vehicle is the same as the configuration that the vehicle should have. A fault memory entry is saved in the VCM if this reveals any discrepancies.

Additionally, upon request the vehicle configuration management system generates lists of control units that have specific characteristics.

Finally, the vehicle configuration management system has the task of determining those control units that have different serial numbers since a reference time (writing of SVT nominal).

The Service Department can use this to determine those control units that have been replaced since this time.

After replacement or changes to hardware or software, for instance, it is much easier to reestablish a consistent and working status for the vehicle electrical and bus systems.

Furthermore, the required configuration must not be maintained by each system function itself. This produces savings in component development as well as in system integration and logistics as compared to previous systems. Additionally, faults due to inconsistent configuration information are prevented.

Deviations from the specified configuration (SVT-nominal) and the current configuration (SVT-current) queried by the control units are identified.

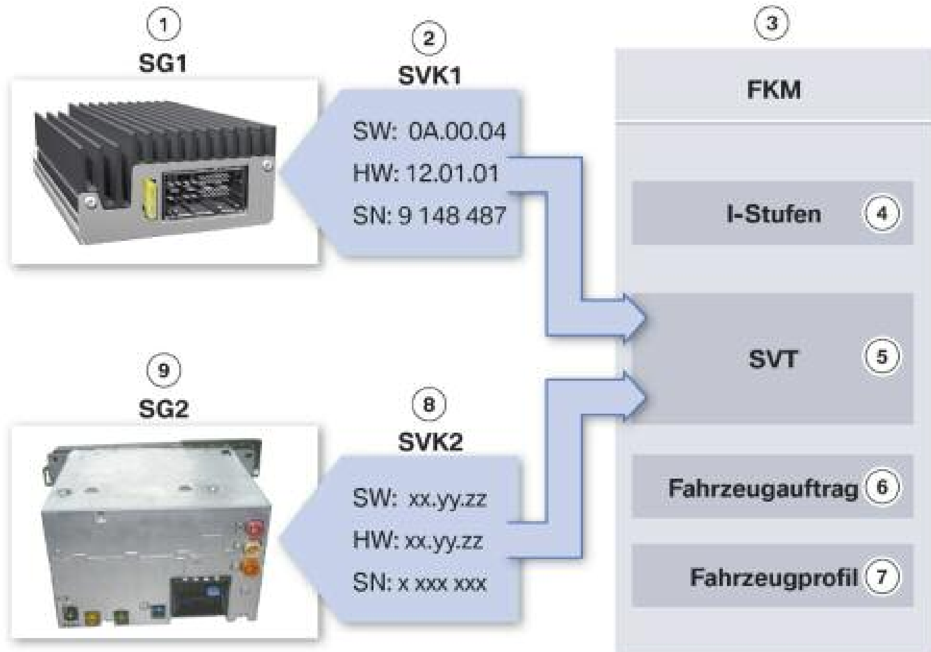
Data Storage

The vehicle configuration management system provides detailed information on the hardware and software installation status of the vehicle. To the outside, the VCM makes available that, and only that, which is relevant for its users. Direct access to internal structures is prohibited and is instead achieved via defined interfaces.

The vehicle configuration management system administers the following data for all electrical components in the vehicle:

- Specified equipment installation table (SVT-nominal)
- Vehicle order (FA)
- Vehicle profile (FP) and
- I-levels.

Storage of data by the vehicle configuration management system



Index	Explanation
1	Control unit 1
2	Equipment installation identification list 1 (SVK1)
3	Data structure in the vehicle configuration management system
4	I-levels
5	Equipment installation table (SVT)
6	Vehicle order (FA)
7	Vehicle profile (FP)
8	Equipment installation identification list 2 (SVK2)
9	Control unit 2

Equipment Installation Table (SVT)

The equipment installation table (SVT) contains all equipment installation identification lists (SVK) of all users installed in the vehicle electrical and bus systems.

The equipment installation identification list (SVK) is a list of all components (software and hardware). The component is not to be confused with the control unit as a control unit may be made up of several units. For instance, a CCC comprizes several software units such as: user interface (BO), antennas (ANT), audio system controller (ASK), gateway (GW) as well as the hardware unit.

The vehicle configuration management system checks the current configuration 10 seconds after the engine start. This creates the current-equipment installation table. The nominal configuration (SVT nominal) is also saved in the vehicle configuration management system. If discrepancies are determined between SVT current and SVT-nominal a fault memory entry is saved in the ZGM.

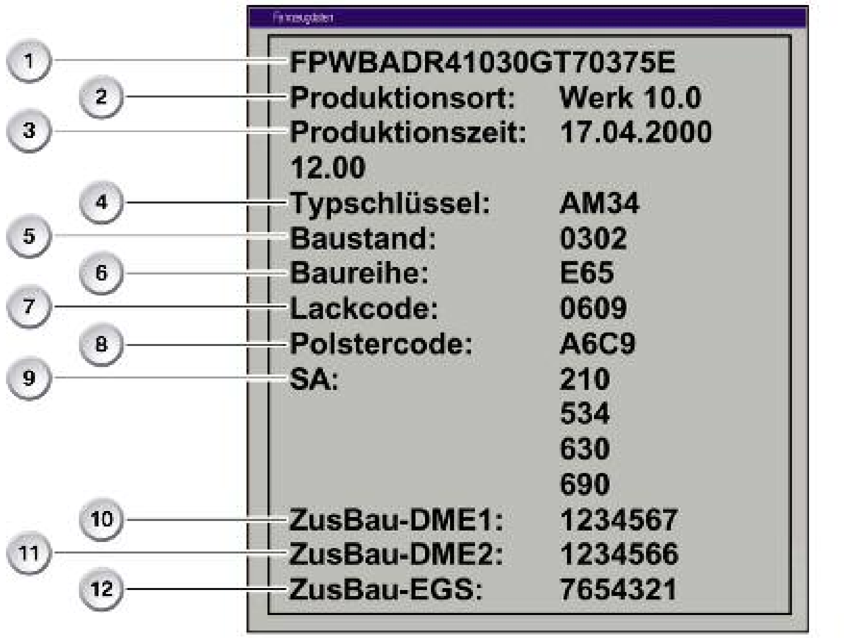
New nominal values are written into the VCM during vehicle programming and coding.

Vehicle Order

The vehicle order contains all the important equipment features of the vehicle in addition to the type code.

The assembly numbers of the drive control units are stored in the vehicle during assembly and can no longer be changed. It is therefore possible at any time to identify which part numbers of the control units were allocated to the vehicle during production.

Vehicle order data



Index	Explanation	Index	Explanation
1	Vehicle identification number	7	Paint code
2	Production location	8	Upholstery code
3	Production time	9	Options (SA)
4	Type code	10	Assembly number DME-1
5	Build date	11	Assembly number DME-2
6	Model series	12	Assembly number 7654321

Vehicle Profile

The vehicle profile contains additional data that precisely describe the vehicle. In addition to the development model series and design they include, for instance, the gearbox type, engine, version etc.

Vehicle order data

Index	Explanation	Index	Explanation
1	Vehicle profile	8	Fuel
2	Development model series	9	Performance class
3	Battery class	10	Gearbox type
4	Design, e.g. Saloon	11	Number of cylinders
5	National-market version	12	Cubic capacity
6	Steering side	13	Version
7	Optional extra (SA)	14	

Integration Levels

In order to keep the testing controllable for the theoretically extremely high possibility of combinations for the installed states of the control unit versions (hardware state, program and data status), so-called integration levels (Ilevels) are defined during the development process of the vehicle electrical and bus systems and during model upgrading.

Extensive tests assure the perfect interplay of all states for the hardware, program data and data of the control unit versions in an integration level.

An integration level (I-level) is a defined vehicle configuration from the electrical standpoint (hardware, software, data, documentation and configuration knowledge) that is fully present at a defined time and which is integrated and accepted compliant with the system acceptance process.

The I-level is therefore a basis, i.e. a reference configuration, for subsequent processes. The most important planned I-levels are defined in development and are scheduled and finalized over the I-level planning for each model series.

For the Service Department, an I-level represents the combination of electronic components for a vehicle in all of its authorized versions with the authorized old states of electronic components. This avoids an unnecessary replacement of control units during programming.

The vehicle configuration management system administers three I-level states:

- I-level ex works
- Current I-level, and
- Last I-level.

I-level Designation

The I-level designation consists of the system reference, SOP date (SOP = Start of Production) and the I-level.

Example: "F001-08-09-500"

F001: System reference

08: Year of series introduction

09: Month of series introduction

500: I-level of the system reference for the series introduction.

I-levels Container (IC)

An I-levels container contains, for instance, the entire software for the control units that is valid in an I-level.

The state of knowledge for each model series is stored in the CIS database.

CIS = Configuration Information System

The CIS database replaces the former KMM database and is used for determination of the vehicle ideal equipment installation status.

Initialization of the Vehicle Configuration Management System

Initialization of the VCM means the first writing of data. All data (SVT-nominal, vehicle order, vehicle profile and the I-levels) is written into the central gateway module through the initialization.

Initialization takes place in the factory and must always be performed when the ZGM is replaced.

Initialization is automatically performed by the programming system. Data from the vehicle order (FA) and I-levels on security are always stored in the CAS. The programming system firstly collects these data from the CAS and then writes them into the ZGM.

Reading and Writing of Data

The SVT-current, SVT-nominal, vehicle order, vehicle profile and the I-levels can be read out from the VCM via diagnosis. These data are written in the VCM during vehicle programming and coding. SVT nominal, FA, FP and I-levels can be written independently of each other.

For data security reasons, signatures are used in the data exchange between the diagnosis or programming systems and the VCM.

Example of Vehicle Configuration Management

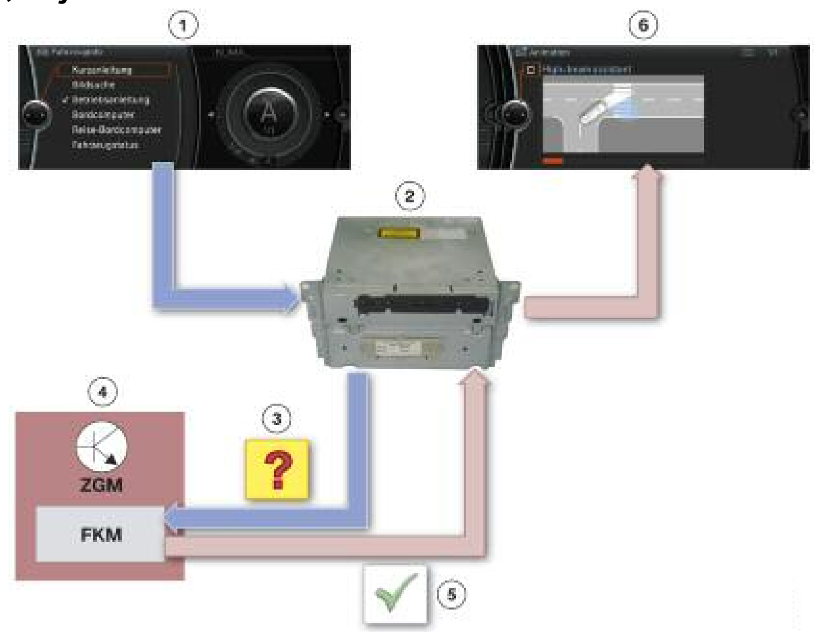
Upon request by other system functions (e.g. integrated Owner's Handbook), the VCM extracts a control units list, e.g. a list of all installed control units, from the SVT-current.

All the contents of the integrated Owner's Handbook are stored in the CIC, but only the vehicle-specific contents are shown. For instance, the CIC queries whether the high beam assistant is installed. If it is, the contents on the high-beam assistant are shown (graphic illustration on the next page).

Further system functions that revert to information from the VCM are, for instance:

- Personal profile (needs information on changes to the vehicle configuration)
- Diagnostics Master (needs list of the actively signalling control units).

Query to VCM on installed control units



Index	Explanation
1	Integrated Owner's Handbook is called up
2	CIC (queries the VCM on installed control units and makes vehicle-specific contents available)
3	Query to the VCM on installed control units e.g. high-beam assistant or KAFAS
4	VCMin the ZGM gives information on installed control units
5	The high-beam assistant or KAFAS is installed in this vehicle
6	The appropriate notes on this topic are shown in the CID

SWEEPING Technologies

SWEEPING technologies allows protection against copying, usage and manipulation of IT components and their software.

The abbreviation SWEEPING stands for Software Enabled Electronics Platform for Innovative Next Generation Technologies.

SWT logo

SWT is based upon an encryption process that uses a key specific to a vehicle and control unit, the activation code as it is called, to activate a software function or application for a control unit.

The activation code (Freischaltcodes - FSC) is input in the Service Department or by the customer.

This occurs either by an input in the controller or through the import from CD/DVD or USB stick as an import medium for the BMW programming system.

The activation code is then subsequently input in the respective vehicle via the BMW programming system.

The required software is operable only after input of the activation code.

Activation by Means of Activation Code

Introduction of SWT Hardware Activation

The first activation code for a BMW vehicle was used in March 2006 for activation of the night vision camera following a replacement.

The hardware component was activated and therefore made operable.

A legal requirement was the background for this. Strict conditions applied for the night vision camera that was developed especially for military purposes.

They could only be installed in registered vehicles. This allowed the vehicles with SA 611 (night vision) to be recorded and accounted for in strict conformity with license conditions.

Furthermore, usage of a FSC allowed clear allocation of the hardware component (night vision camera) to the vehicle in which it was installed.

An activation code for the night vision camera following a replacement was enclosed in the form of a CD. This so-called "subpart" had to be ordered by the parts technician over the EPC by giving the vehicle identification number.

The activation code located on the CD was requested by the BMW programming system during the programming. It was then transferred into the BMW programming system and imported into the vehicle.

If a FSC was not entered during programming or coding, it was not possible to activate BMW Night Vision. This was displayed after programming/coding by a Check Control message in the instrument panel.

Introduction of SWT Software Activation
In March 2007 the activation of single software components was commenced at BMW. This laid the foundation stone for the business model "software as a product".

It allowed functions already installed in the vehicle to be made usable for the customer and to activate them by means of an activation code.

This in turn created the opportunity to invoice software licenses individually with the supplier and only after its activation. In addition, copy protection was hugely improved by activation code activation, an asynchronous encryption method.

Activation of the Voice Recognition System in the CCC:
An activation code for the voice recognition system (SA 620) in connection with CCC (SA 609) became necessary when programming a vehicle from Progman V25.0, as the voice recognition system could no longer be used without this.

This applied for the retrofit of software for the voice recognition system as well as for replacement of the CCC.

Savings in license costs was the background, as invoicing could now be carried out with the software manufacturer separately for each vehicle instead of a general license.

When programming of the CCC (SA 609) was carried out on vehicles up to March 2007 fitted with the voice recognition system (SA 620) or voice recognition system preparation (SA 6UB), the BMW Programming system requested an activation code.

This activation code was located on a separate DVD or in the ASAP portal (only available in the ASAP portal after prior completion of an order).

On vehicles with a production date from March 2007 (I-level 07-03-5XX or higher) the activation code was contained in the CCC.

In the event of a hardware replacement for the CCC however, it is not possible to import the code from the SWT disc. The data does not exist on the CD.

The necessary code has to be ordered together with the replacement module via EPC and will be delivered via the ASAP portal (see page 124).

SWT CD for input of the activation codes
*** only for vehicle produced before 3/2007**

Note: Vehicles produced from 3/2007 require an activation code acquired from the ASAP portal.

SWEEPING Technologies in the F01/F02

From the F01/F02 the activation of software applications and function has been increasingly expanded.

It is now possible to activate the following applications or software functions via FSC:

- Software for voice recognition (SA 620)
- Navigation system application software (SA 609)
- Navigation system map data (activation code required from the second half of 2009).

The activation code for the software applications and software functions named above is loaded over the BMW programming system into the vehicle in nearly all cases. The CD is still necessary for activation of the camera for the night vision camera following a replacement.

Navigation system map data

Update of map data for the navigation system and input of the activation code

Since 09/2008 with introduction of the Car Information Computer, the navigation system map data is stored on a hard disk in the CIC.

Input of the map data is currently possible from the DVD drive and in later production vehicles over the programming system.

The activation code can also be entered over the programming system or via the controller of the iDrive system. An input aid (speller) is available in the iDrive display for this purpose.

This activation code along with the current navigation software (Navigation DVD) is handed to the customer when the customer purchases the map update.

When the order is placed for the activation code, the parts technician states the vehicle identification number of the vehicle for which the navigation map is to be updated.

A special activation code is consequently created in the BMW AG headquarters, in which the vehicle identification number becomes an element of the FSC.

This means the issued FSC and navigation DVD can only be used for the vehicle requested.

The initial filling of the hard disk integrated in the CIC with map data can, if this manufacturer has not already filled it, only be carried out over the BMW programming system.

For the update of map data, only the cash sale variant with activation code input via the speller is subsequently available.

Delivery Process of the Activation Codes Over ASAP

The majority of software functions and applications are not activated by customers, rather by BMW Service employees over the BMW programming system.

A special process was created for BMW employees to request the activation code from the BMW AG headquarters, to download it to the workshop PC and then to import it into the corresponding vehicle over the BMW programming system.

The part number for the activation code is available after input of the vehicle identification number in the EPC (Electronic Parts Catalogue).

Upon request from the BMW Service employee, the parts technician orders the activation code over the appropriate Dealer Management System.

The activation code is now created in the BMW AG headquarters. It is normally available to the Service employee in the ASAP portal within a very short time.

Note: The delivery time for the activation code may be delayed for up to one workday due to country-specific circumstances and the world-wide time difference.

The activation code is now ready for download as a ZIP folder (content = 3 files) in the ASAP portal and is shown after input of the corresponding vehicle identification number.

This ZIP folder must be saved in a temporary directory for subsequent extraction of the contents.

These "unzipped" contents are now to be saved in on a CD/DVD or via the use of a USB stick as long as it has been formatted as a removable disc.

Note: No external USB hard drives will be supported. Not all USB devices are compatible with the sytem.

Note: Cancellation of the activation code is only possible before the start of the download. Therefore, a check should be made before the download of whether the vehicle identification number of the customer's vehicle is correct. The activation code is invoiced when the download starts even though it has not been installed in the customer's vehicle.

Cancellation after the download is therefore no longer possible.

Input of the Activation Code into the BMW Programming System

The medium containing the three unzipped files is inserted into the ISSS so that the BMW programming system can access these FSC data.

After the import button has been pressed, follow the on screen instructions to complete the import process.

ISSS

Import of the activation code into the BMW programming system

Planned Expansion Stages
In the expansion stage of the BMW programming system planned for the future, the data import of the activation code is to happen automatically.

This would mean that after the request by the parts technician, the activation code, would be directly available to the BMW programming system after a short waiting time.

This process, called "SWT-Online", plays an important role particularly for repairs. Because after replacement of a Car Information Computer, for instance, work can be carried out on a repair without an activation code having to be ordered. It is made directly available to the BMW programming system by "SWT-Online".

However, it is still necessary to place an order over the parts technician and the Dealer Management System for software that has to be paid for, such as the voice input system.

"SWT-Online" or the ASAP portal can be selected afterwards as the delivery channel.

Cancellation of the activation code is however only possible over the ASAP portal.

The channel over the ASAP portal, with download onto the workshop PC and subsequent import into the BMW programming system, should therefore continue to be used as the backup-solution.

Should problems occur during the download or data import into the vehicle, technical support of the respective market should be contacted or a PuMA instance created.

Vehicle Security

History and Fundamentals

Vehicle security protects the vehicle electrical and bus systems against unauthorized manipulative external access.

The topic of vehicle security experienced its beginnings with the introduction of the E28.

On this 5 Series, an instrument panel with encoding connector (coding plug) was installed from 1980.

When a new instrument panel was installed, the encoding connector of the old one had to be used. If this was not done a manipulation dot lit up to indicate that the kilometer reading had been manipulated.

The kilometer reading was only reset to the correct reading with the old encoding connector. The manipulation dot was no longer displayed.

A new era in manipulation protection begins with introduction of the master security module (MSM) as a module in the central gateway module in the F01/F02 and the client security module (CSM) in some selected control units.

The basis for the requirement for the vehicle security system is formed by the growing amount of electronics and the interlinked networking installed in the vehicle.

Mention must also be made of the increase in driver-based services.

Threat Potential

As electronics increase in vehicles, the possibilities also increase of disrupting and infiltrating this sensitive system through manipulation, imitation of hardware and software, and tuning measures (blackbox tuning).

Data storage in the vehicle (e.g. Contacts menu) also means that adequate data protection must be provided.

Vehicle Security Measures

The measures below are carried out to be able to ensure vehicle security in the F01/F02:

- Periodic check of software signatures (signature = digital, electronic signature used for checking the completeness, genuineness and intactness of data)
- Individual stamping of control units on the vehicle in which they have been installed
- Cryptographic protection of the teleservice access
- Encryption of personal data
- Periodic checking of memory ranges.

Benefits for Customers

The vehicle security system actively protects the personal data of the customer and actively guards the vehicle electrical and bus systems against attempted manipulation from outside.

Benefits of the Vehicle Security System for the BMW Group and the BMW Brand
For the BMW Group, the vehicle security system contributes towards unjustified liability and to warranty costs not being accrued for manipulation.

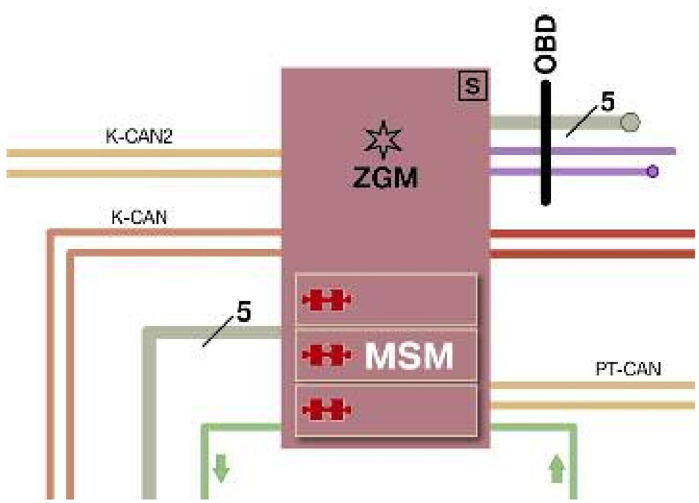
Furthermore, vehicle security has the purpose of preventing vehicles damaged by manipulation giving a bad public image to the BMW brand and therefore damage to our reputation.

Architecture of the Vehicle Security System

The vehicle security system is comprized primarily of the master security module.

This master security module (abbreviated as MSM) is located in the central gateway module of the F01/F02.

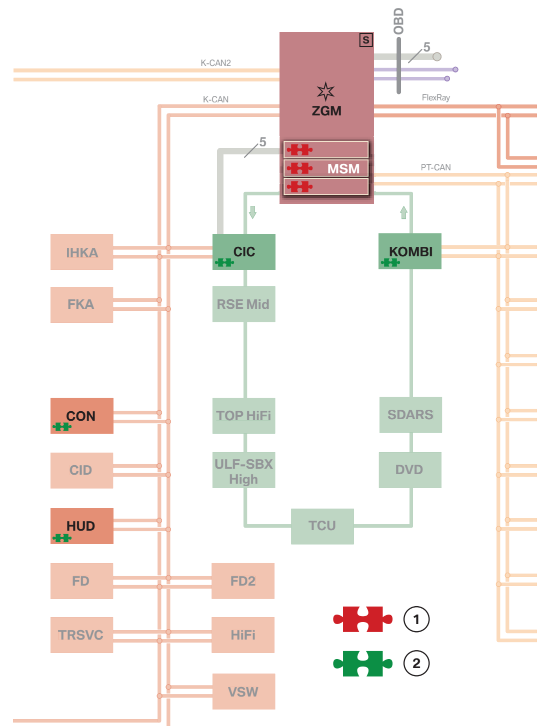
Master security module in the ZGM of the F01/F02



Secondly, the vehicle security system comprizes the client security modules located in the control units below that are monitored by the master security module:

- CIC - Car Information Computer
- KOMBI - Instrument Cluster
- HUD - Head-up Display
- CON - Controller

Overview of the MSM and the individual client security modules



Index	Explanation
1	Master security module in the central gateway module
2	Client security module in the individual control units

Vehicle Security Operating Principle
The master security module periodically transmits queries to the individual client security modules.

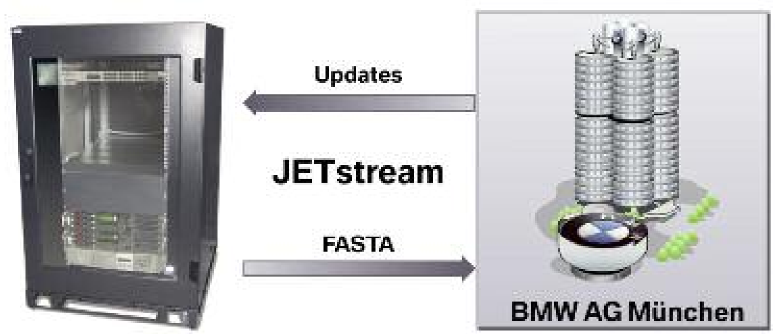
Any faults and discrepancies are documented and notified to the BMW AG headquarters during transmission of the FASTA data via Jetstream during a service visit.

It is not possible for Service Department employees to use BMW diagnosis systems for accessing the information regarding manipulation stored in the control unit.

Possible faults and discrepancies in the vehicle security system are:

- A control unit was replaced without authority
- A control unit was manipulated through a change of software or data status
- Communication to the MSM was interrupted or manipulated for a control unit with a CSM.

Preservation of Function in the Vehicle Security System
Any manipulation found in the vehicle security system must not have a negative impact of functions relevant for security within the vehicle electrical and bus systems.



Data transmission via JETstream

Integrated Service Technical Application - Programming

Reasons for introduction of the new programming system

Due to the constantly growing complexity and ongoing development of functions over the life of vehicles, adaptation of the software on the control units is unavoidable.

The launch of the F01 brings with it a new generation of vehicles which have not only new functions but also a new control unit architecture and a new electrical system configuration.

In order to ensure that those technologies can be supported by the dealer organization today and in the future, a new workshop system is being introduced alongside them.

The new workshop system incorporates an extensive workshop network with a central server for data storage and provision of the applications. It also introduces new hardware components for diagnosis and programming.

The existing programming system, Progman, is being replaced by the Integrated Service Technical Application for Programming, ISTA/P.

ISTA/P contains the present vehicle field programming functions plus new functions and is thus designed for the future content and requirements of vehicle programming in the field.

The introduction of ISTA/P will result in the following new features as compared with Progman:

New features when compared with Progman

- Reduction and combination of input demands.
- Configurable measures plan viewable as a graphical chart or a table.
- Detailed display of control unit status.
- Automatic repetition of programming in the event of control unit programming or coding errors within the programming process.
- Importing of enabling codes/vehicle order from any location in the workshop provided there is access to the workshop system/ISTA/P.
- Measures plan can be subsequently extended and adapted.
- Programming takes place first followed by automatic coding of all control units.
- Proactive saving of customization and CBS data and re-importing into control units from F01 on.
- Saving of personal profile settings such as phone book or navigation destinations, depending on control units fitted.
- Generation of a control unit order list if hardware needs to be replaced.
- Session can be saved if parts are not immediately available.
- Display of the Progman or ISTA/P version that was last used to program the vehicle.
- Timely/faster updates.

Release Phases

The new programming system ISTA/P is to be introduced in several phases.

Phase 1
Phase 1 requires the transformation of the Software Service Station, SSS, into the Integrated Software Service Station, ISSS. This "Phase 1", allows the ISSS to be integrated in the ISIS network.

The actual data/software (ISTA/P application) needed to program the vehicles is installed in the will be on the ISSS. Updates will be applied to the ISIS via Jetstream or from DVD and then passed on to the ISSS during the maintenance cycles (off-business hours).

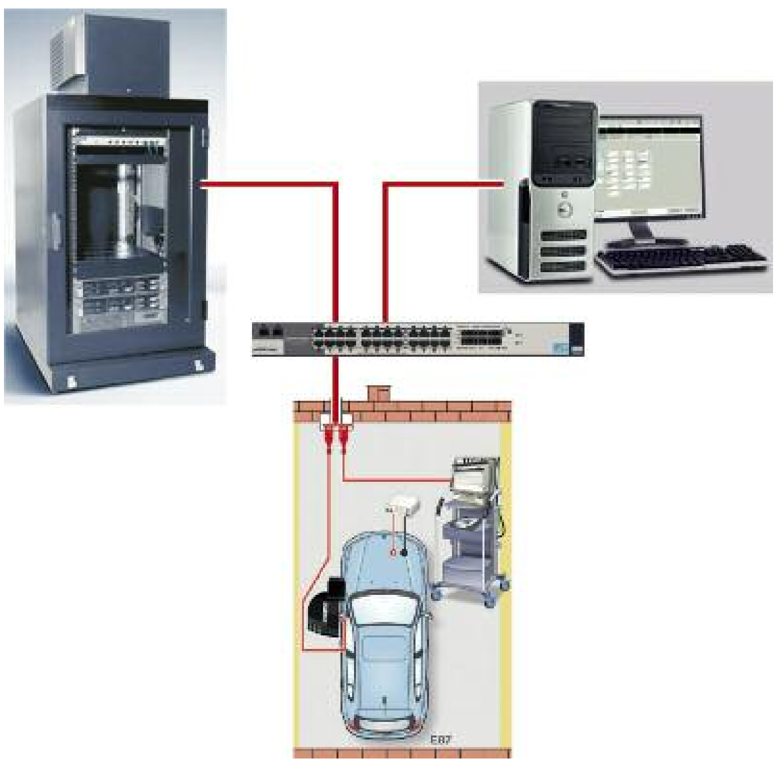


Illustration of Phase 1

ISTA/P is capable of programming and coding all models.

Initially, the interface and control for programming can only take place by using keyboard and mouse on the ISSS. Soon after, programming control can take place via each individual ISID in the workshop.

The ICOM A and the ICOM B will be used as vehicle interface for programming. The ICOM B will be used exclusively for programming MOST control units.

From the introduction of the ethernet connection in the OBD2 interface, ICOM B will not be used. (example: F01/F02)

Future Phases
It is planned to integrate the programming system ISTA/P entirely in the ISIS workshop server. A precise timetable for integration of ISTA/P in ISIS has not yet been finalized.

Illustration of development planning

Transforming an SSS into an ISSS

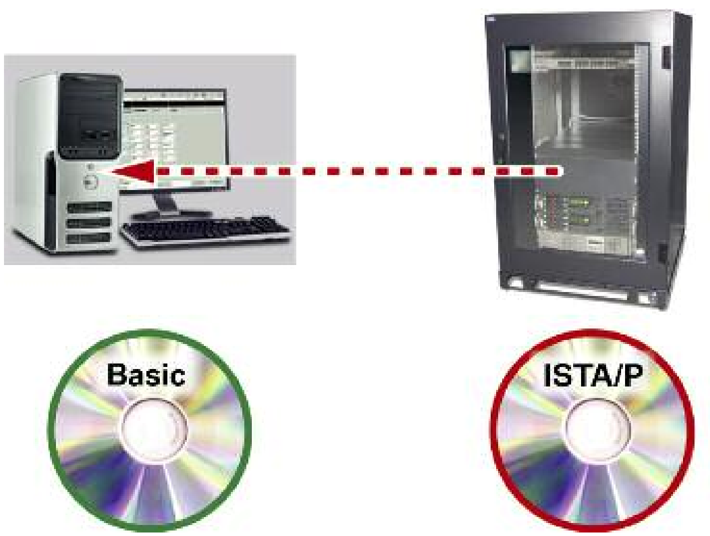
The technical requirements for conversion demand that the SSS is at least the 2nd generation (release 2). The 1st generation SSS can not be converted.

A starter pack containing the following items will be needed:

- ISSS - basic DVD (1 disc)
- ISIS - ISTA/P client (1 disc)
- ISIS ISTA/P data/software (2 disc)

First, the basic DVD is placed in the DVD drive on the SSS and the operating system installed on the SSS. In the process, the previous application, Progman, is completely deleted. From this point on, future, updates and installation of the ISTA/P application on the ISSS will take place exclusively via the ISIS.

The ISTA/P client and then application software are installed on the ISIS. The ISSS is updated/supplied with the application software by the ISIS via the network during the maintenance cycle.



Transformation of SSS into ISSS

Programming

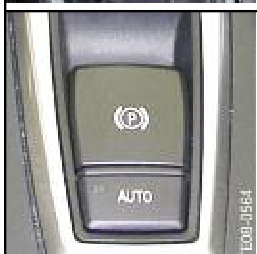
As a fundamental rule, a vehicle may only be programmed in the following circumstances:

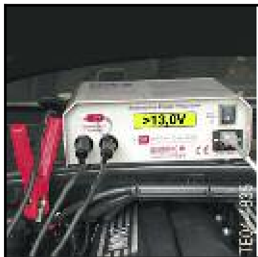
- If a diagnosis system test module instructs that programming is to be carried out
- As part of a technical campaign
- In the course of conversions or retrofits
- If the BMW Group technical support (e.g. via PuMA) specifically instructs that a vehicle is to be programmed.

Similar to An important factor for error-free programming is proper preparation of the vehicle and observance of the instructions during programming. There are special requirements that may apply to individual vehicle models. The actions that are required for all models are described in the following pages.

Note: Programming must always be preceded by carrying out a diagnosis on the vehicle and making sure that there are no faults on the vehicle. Programming must not be started before faults in the vehicle electrical system are ruled out. Always refer to the latest bulletins and information on currently known issues involving software releases.

Preparatory Measures

	**Engine** Turn off engine, ignition key turned to terminal 0
	**Manual gearbox/SMG/DKG** - Transmission in neutral - Parking brake applied
	**Automatic transmission** - Transmission in position P - System temperature below 80 °C
	**Parking brake** On vehicles with electromechanical parking brake, apply the parking brake by means of the parking brake button, otherwise use the handbrake.
	**Electric loads** All electric loads, lights and turn indicator switched off. Wiper/washer system switched off. Make sure that the wipers can move freely. The wipers may be activated during programming. On no account block the wipers.

	**Battery and Battery charger** The battery should be sufficiently charged at the start of the programming procedure (>13 V). Connect a BMW-specified and approved battery charger and set to external power supply mode (FSV mode). Do not connect or disconnect the charger during programming. The electrical system voltage must not drop below 13 volts during the programming procedure.
	**Diagnosis** Carry out a vehicle test on the ISTA workshop system. Using the ISTA diagnosis system, rectify any problems before programming and delete stored fault codes.
	**Interfaces** Programming is performed exclusively via the ICOM devices. Any vehicle equipped with a MOST bus manufactured before the F01/F02, will require the use of an ICOM A and an ICOM B.
	**Programming** CKM data is automatically saved by ISTA/P and written back to the control unit after programming. The data status of the ISSS must always be up to date.

Programming of Control Units

The programming system ISTA/P ensures updating of the data statuses on all vehicles by automatically generating a measures plan that should be implemented on vehicles that are bound to an i-level status.

In this context, a distinction is made between three different options. Each of these options represents a change or adaptation to the software and functions. A distinction is made between three measures:

- Programming
- Coding
- Customizing.

Programming

Programming (also known as flash programming) loads a new program or data in the control unit. A distinction can be made between control units with:

- Program status and
- Program and data status.

The program status of the control unit corresponds to the operating system and controls the computer program in the control unit. The data status involves the characteristic maps and characteristic curves specific to the vehicle, engine and transmission. The ISTA/P programming application automatically takes that into account when programming the control unit concerned.

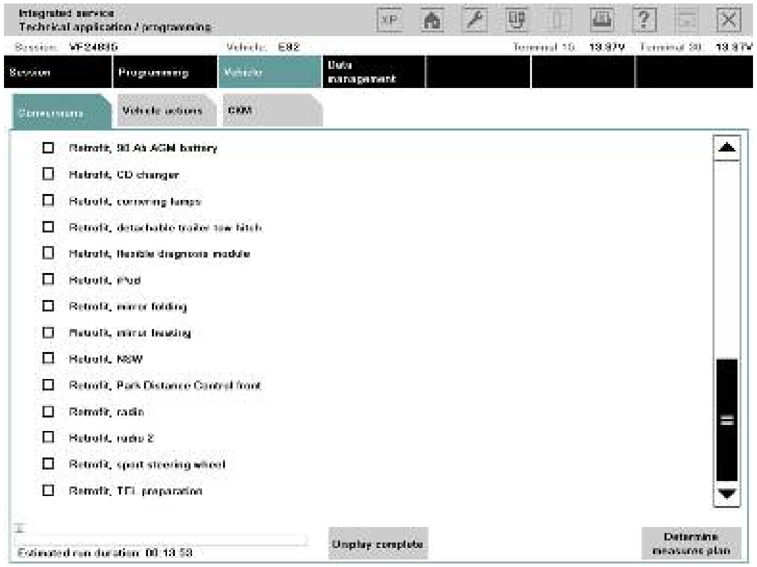
With ISTA/P, the control unit has been programmed, any necessary coding procedures are performed automatically.

Coding

Coding involves adapting the control units to the specific vehicle. That means that functions and data maps already in the control modules are enabled or activated in accordance with the vehicle order for the vehicle.

Customizing

On older vehicles, the car and key memory (CKM) option located under the Vehicle option is used to enter the customer-specific settings for the car and key memory functions on certain electrical systems.



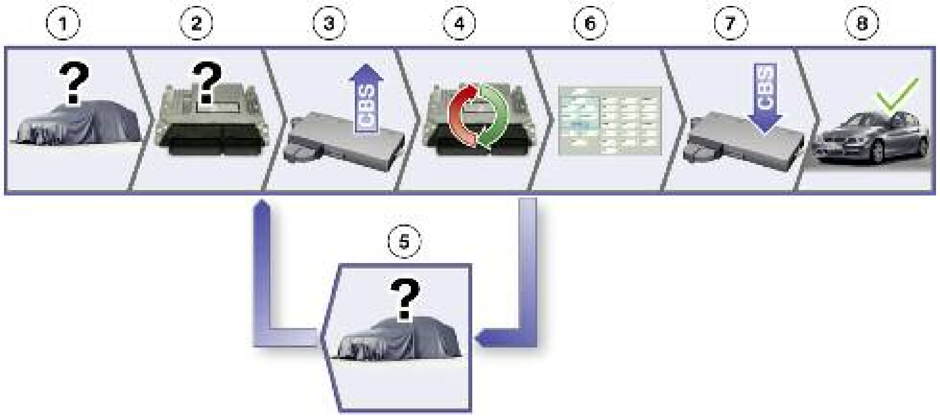
Personal Profile

On vehicles with the Personal Profile function, the customization settings are entered directly by the customer. For such vehicles, there is no Customize button on the Vehicle menu.

Programming Process

The programming process consists of various procedures, some of which require manual intervention although most are automatic.

The individual procedures are illustrated here and described in detail below.



Programming process sequence

Index	Explanation
1	Identify vehicle and obtain read-out of control unit data
2	Produce and configure measures plan
3	Prepare for programming, export CBS/CKM data
4	Carry out repairs and replace control units where necessary
5	Re-check vehicle identification after repairs. Update measures plan.
6	Carry out programming
7	Carry out programming follow-up, import CBS/CKM data
8	Programming successfully completed.

Starting Programming

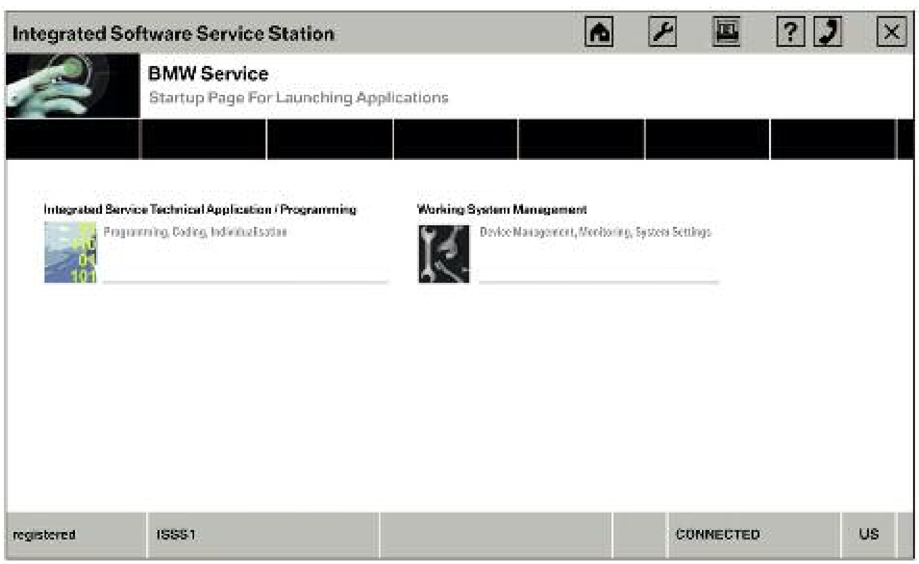
Essentially, ISTA/P is an independent external application that will run on the ISSS in Phase 1.

Although in a latter stage ISTA/P can be started from the ISID, it is entirely independent of the ISTA diagnosis application. That means that before programming can be started, diagnosis must be ended or interrupted.

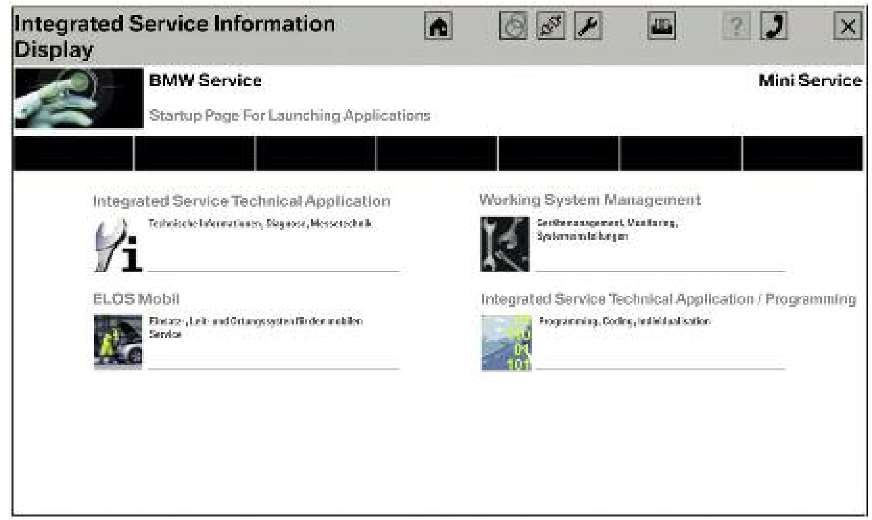
Starting and management of a new programming session can only be carried out by means of ISTA/P.

When ISTA/P is started, the user has a choice of three different actions:

- Cancel and exit ISTA/P
- Open an existing programming session
- Start a new programming session.



Start screen on the ISSS Integrated Software Service Station



Start screen for ISID (not enabled initially)

Opening an Existing Programming Session

If the user decides to open an existing programming session, all the programming sessions currently in progress are listed and the user can select the session required.

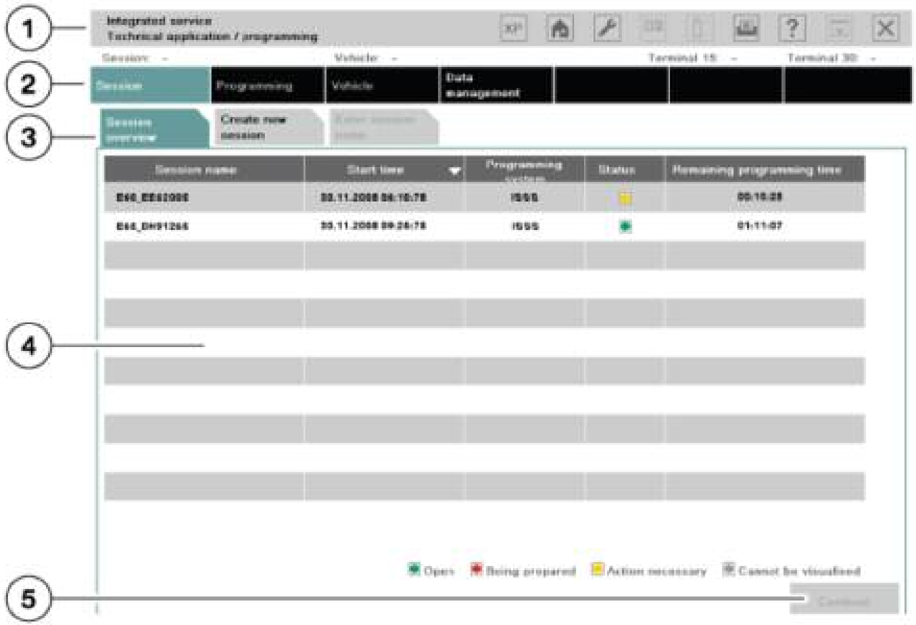
On the toolbar there are various buttons for opening more menus.

On the options bar, you can select the session or the vehicle that is to be programmed or the Integrated Software Service Station (ISSS) that is to be used for programming. Depending on the vehicles models connected, each ISSS can carry out up to five programming sessions at the same time.

On the function bar is the button for selecting the vehicle access method.

The information panel shows the details of the sessions or available ICOMs.

The control buttons are used to navigate through the programming process, e.g. the "Next" button takes you to the next screen.



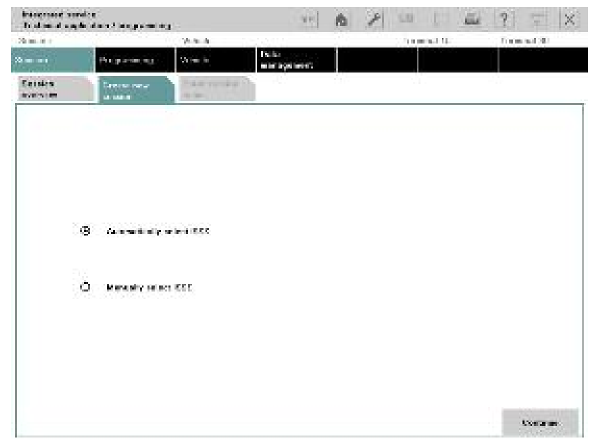
List of current sessions

Index	Explanation
1	Toolbar
2	Options bar
3	Function bar
4	Information pane
5	Control buttons

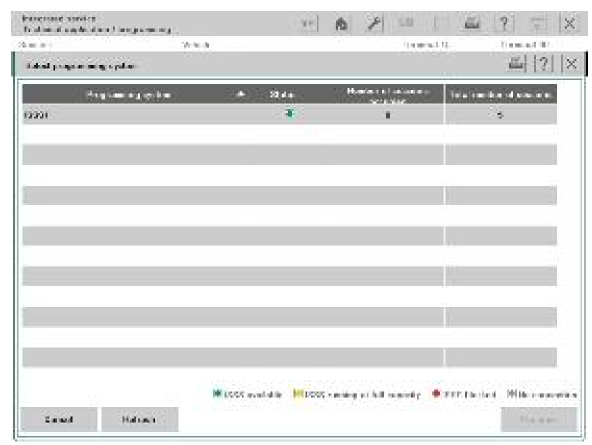
Starting a New Programming Session

When a new programming session is to be started, the programming server on which the vehicle is to be programmed must first be selected.

The ISSS used for the session can be selected manually or automatically. Because the ISSS can only program one F01 at a time or 5 other vehicles at a time, it is recommended that the automatic ISSS selection is carried out.

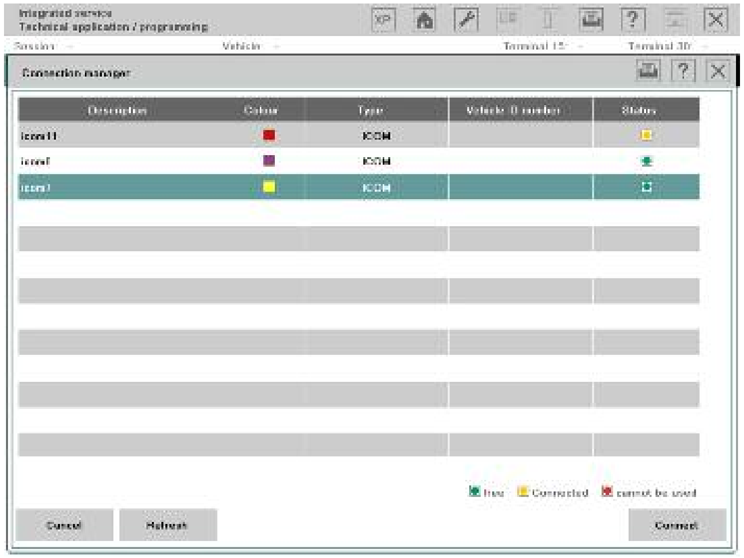


Selecting ISSS to be used for session



Selecting ISSS to be used for session

The connection manager on the ISIS establishes all the ICOMs that are available and displays the details. The user can select the desired ICOM or vehicle from the list displayed. ISTA/P then establishes the vehicle data. If that is not possible for any reason, the vehicle must be selected manually.



Selecting ICOM

The user then has the opportunity to give the session any individual name, but the system automatically enters the model of the vehicle along with the chassis number as an identifier (example: E60_EE12345).

Selecting Vehicle Interface

The same vehicle interfaces are used for programming with the new workshop system as for diagnosis.

From the F01 on, all control units can be programmed using only the ICOM **A**. Even though the F01/F02 is equipped with a MOST bus, ICOM **B** is not necessary due to the ethernet connection via the OBD2 connector.

For CAN-bus vehicles the ICOM A is used. MOST control units are programmed directly using the ICOM B. The ICOM B is connected to the ICOM A and the workshop network by a USB cable.

For older I-bus/K-bus vehicles with the round diagnosis connector, the ICOM C (C) is used in conjunction with the ICOM A.

Vehicle interfaces

Vehicle Access for MOST Bus

When programming vehicles with MOST bus from E65 to E9X, vehicle access is established as shown in the photograph below.

Vehicle access for programming MOST-bus vehicles

Vehicle Access for I-bus/K-bus Vehicles

On older vehicles without OBD II connection, programming is carried out via the round diagnosis connector in the engine compartment. That requires connecting the ICOM C to the ICOM A and to the workshop network.

Vehicle access for I-bus/K-bus vehicles

Vehicle Access from the F01/F02 on

All control units will be programmed exclusively using the ICOM A.

Vehicle access from F01/F02 on (only ICOM A needed)

Identifying the vehicle and obtaining a read-out of control unit data

ISTA/P checks the vehicle electrical system, the central gateway and the vehicle-order control units (FRM/CAS/light module). The vehicle order is read and a consistency check carried out between the actual status and the required status.

If the central gateway does not respond, a software routine for restoring it to working order is attempted before the service technician is instructed to replace the ZGW.

First of all, the basic details of the vehicle are established such as VIN number, model, type code, etc.

Then, all control units fitted and the current I-level of the vehicle is determined. In addition, the programming system establishes, if possible, the software version last used to carry out servicing operations on the vehicle.

That makes it possible to avoid unnecessary programming if the vehicle already has the latest software version.

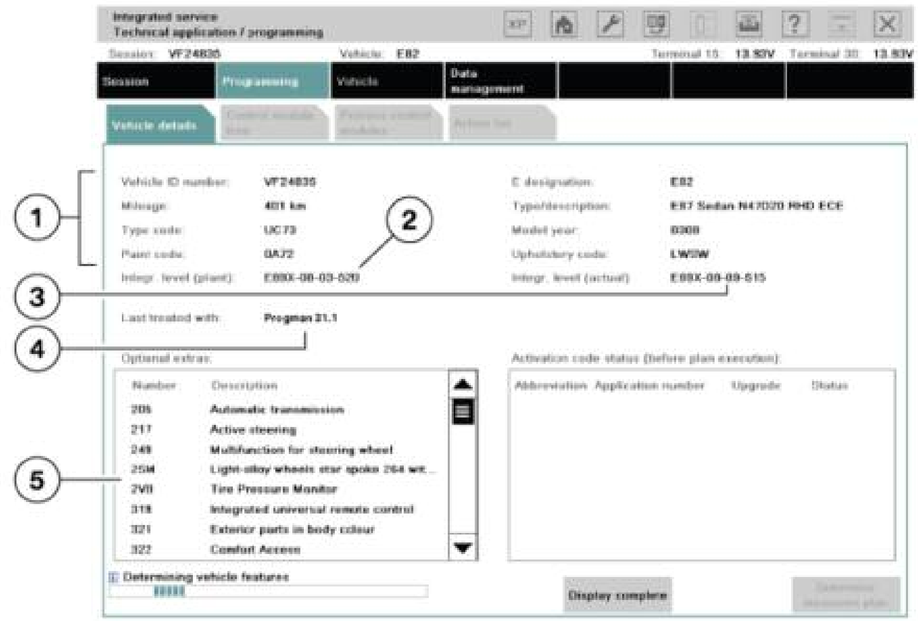
Afterwards, the details of the ex-works equipment options for the vehicle stored on the BMW programming system are retrieved.

Next, the control units identified and the equipment options fitted are compared (comparison of required vs. actual status).

For example, it is established whether the list of control units obtained actually matches those fitted on the vehicle and whether the Ilevel matches the current required status.

That ensures that all control units on the vehicle communicate properly with one another within the network. An I-level is a combination of networked control units validated and approved by BMW Development.

Establishing vehicle details

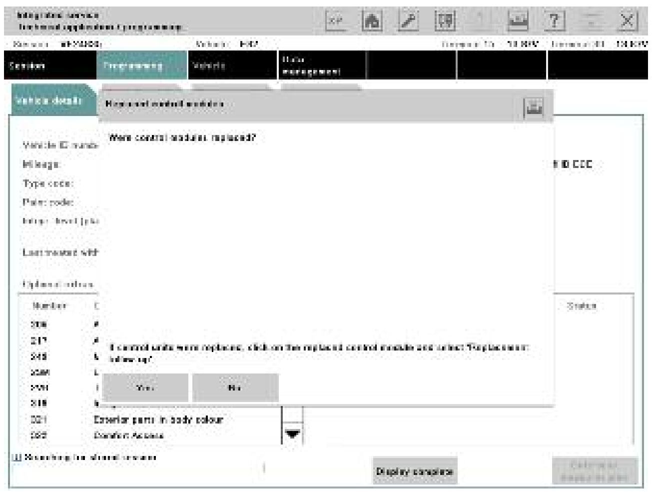


Index	Explanation
1	Vehicle data
2	I-level with which the vehicle left the factory
3	Current I-level of the vehicle
4	System and version last used to program the vehicle
5	List of all optional equipment fitted on the vehicle

Producing and Configuring the Measures Plan

Before programming can be carried out, the measures plan is produced and can also be configured by the user. For example, it is now possible to program refits or conversions at the same time as the software update. The configuration for that is done now so that no further manual input is required later on during the programming sequence and it can then run automatically.

After the identification process, the user is asked if any control units have been replaced on the vehicle. If the answer is YES, ISTA/P checks whether an enabling code is required for the replaced control unit and, if so, requests it from the user if it has not already been entered on the system.



Control unit replacement check

Associated customization data such as settings for the air conditioning are backed up and the action "Follow up control unit replacement" added to the list of actions.

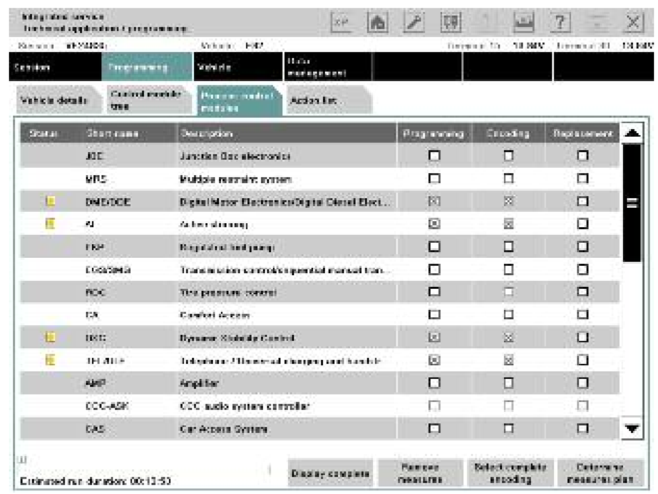
In general it is advisable to manually back up the customer's individual settings. If the control unit is defective, they can not be read and, therefore, can not be written back to the control unit after programming either.

The necessary actions, such as "Update control unit software", are established and added to the list of actions.

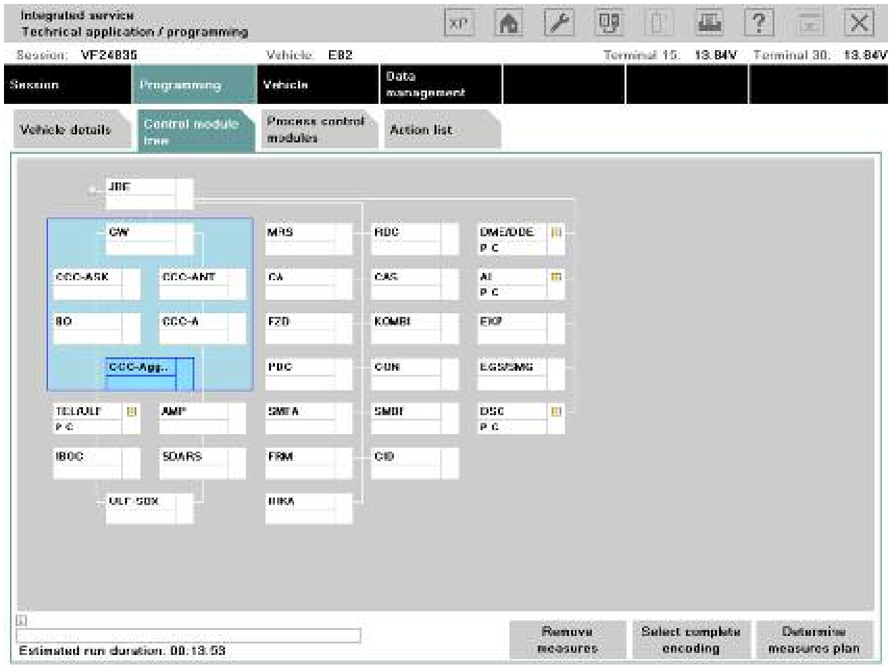
Then for the first time ISTA/P produces an measures plan based on the tasks in the list of actions at that point.

The user has the option of editing the measures plan. The user can add further actions to the measures plan but not remove them. The following actions can be added to the measures plan:

- Carry out conversion
- Prepare control unit replacement
- Program control unit
- Code control unit
- Set CKM data
- Enter enabling code
- Import vehicle order.



Note: Required service functions such as initializations and clearing of fault codes are only indicated; they must be carried out on the ISTA diagnosis system.



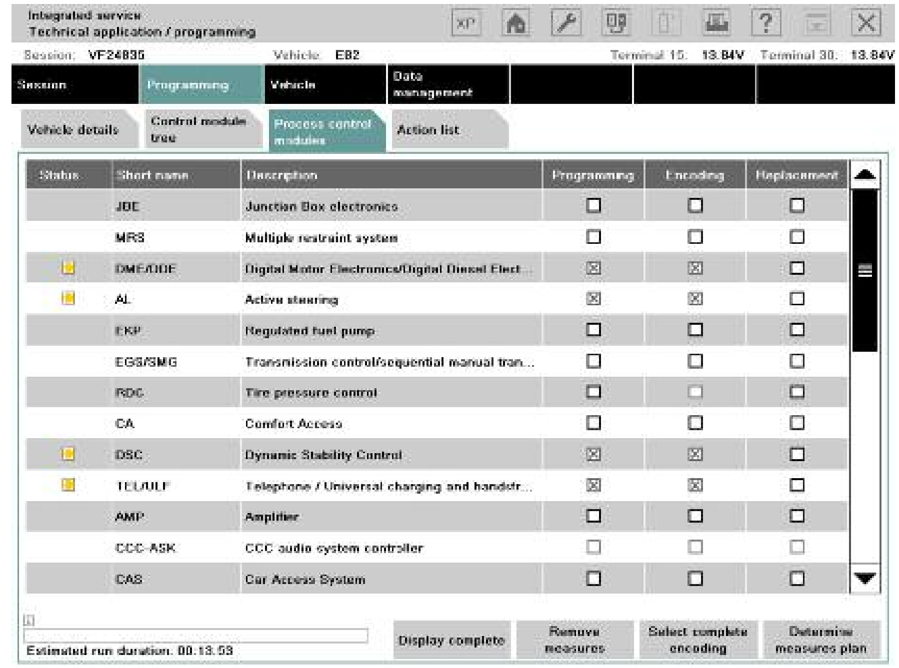
Display of action plan as graphical chart

The measures plan can now be confirmed, rejected or cancelled.

The measures plan indicates which control units do not require any action - they are marked green.

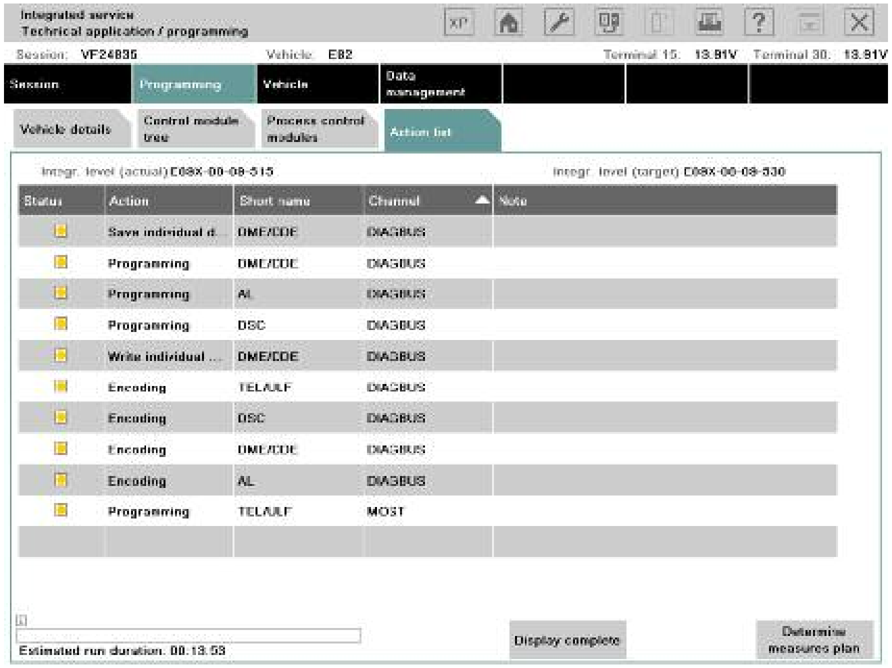
The other control units, on which action is required, are marked yellow or red. The actions that are required are indicated by the letter(s) shown on the control unit. The letters stand for the following:

- **P** = Program
- **C** = Code
- **I** = Initialize
- **R** = Replace
- **M** = Mount (i.e. fit/install)
- **U** = Unmount (i.e. remove).



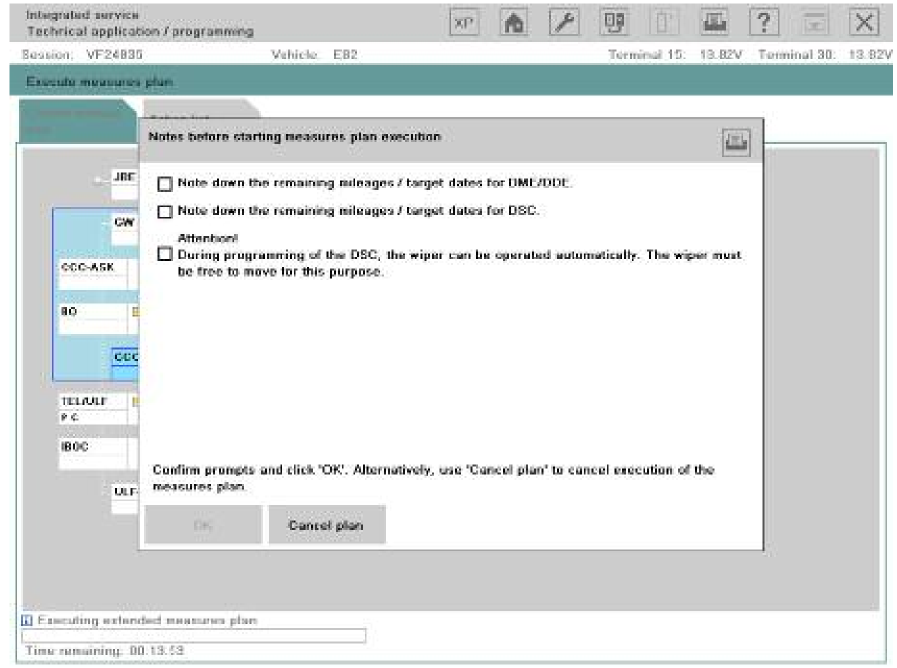
Measures plan shown as a table

The measures plan can be viewed as a graphical chart by pressing the button "Control unit tree" or as a table by pressing the button "Edit control units".



Action list

The Action list contains all information relating to the control unit concerned and which via channel (D-CAN/MOST) it is programmed.



Guidance notes

Furthermore, additional guidance notes can be shown, e.g. on noting the remaining life of DME or conversion instructions for replacing control units.

Note: The guidance notes must be acknowledged by ticking the checkboxes and confirmed by clicking OK.

Preparing for Programming

After confirming the measures plan, the flash programmability of the control units is first checked and a notification message displayed if there is a problem. Then the customization data and the CBS data is read and backed up for rewriting later on.

If a control unit requires replacing, ISTA/P displays a message to the user indicating that the control unit should now be replaced.

After replacement is confirmed, the action "Follow up control unit replacement" is flagged for attention later on in the process.

ISTA/P then shows all required notifications, which must be acknowledged by the user before the actual programming starts.

That simultaneously starts the automatic programming process which requires no further interaction on the part of the user.

Note: As always, please keep in mind that the CAS is programmed first with the key removed. After successfully programmed, the ignition has to be switched on again.

Carrying out Repair Tasks

If it was established in the process of identifying the vehicle that repair tasks are required, e.g. due to updating hardware or replacing a control unit, they are now carried out before the actual programming/coding process.

If the spare part is not available or the wrong part has been ordered, the session can be saved and ended at this point. As soon as the right part is available, the session can be retrieved and continued.

ISTA/P establishes from the measures plan which repair tasks are required and displays them. After successful completion of a repair task, the vehicle must be re-identified and any necessary software updates added to the measures plan.

In that way the possibility of inconsistencies on the vehicle after a repair is avoided. If a repair task fails, the programming process is cancelled.

Updating the Measures Plan

After a repair task has been carried out, ISTA/P performs the vehicle identification process again. If it identifies irregularities, e.g. that a control unit with an older I-level status has been fitted, appropriate actions are automatically set on the system or indicated to the user.

If there are irregularities, ISTA/P establishes which software updates are required based on compatibility management and adds them to the action plan. The measures plan is then updated and programming automatically started.

To prevent vehicles with inconsistencies being created, the user has no means of stopping the programming sequence.

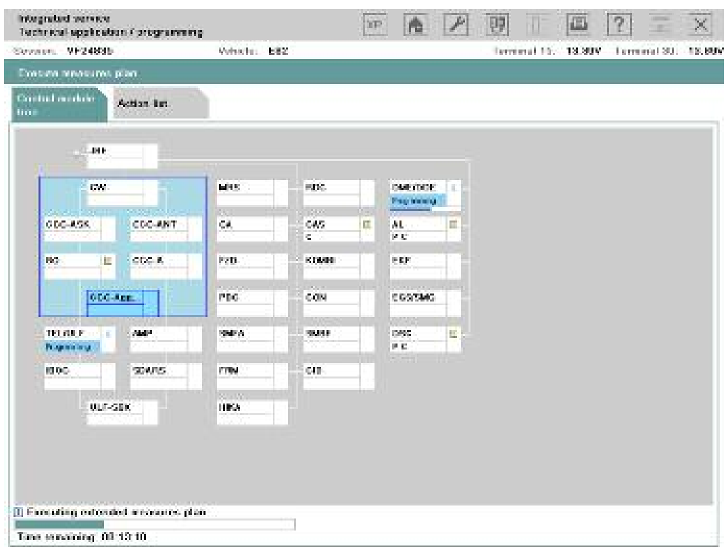
Carrying Out Programming

This stage of the process involves the programming and subsequent coding of the control units.

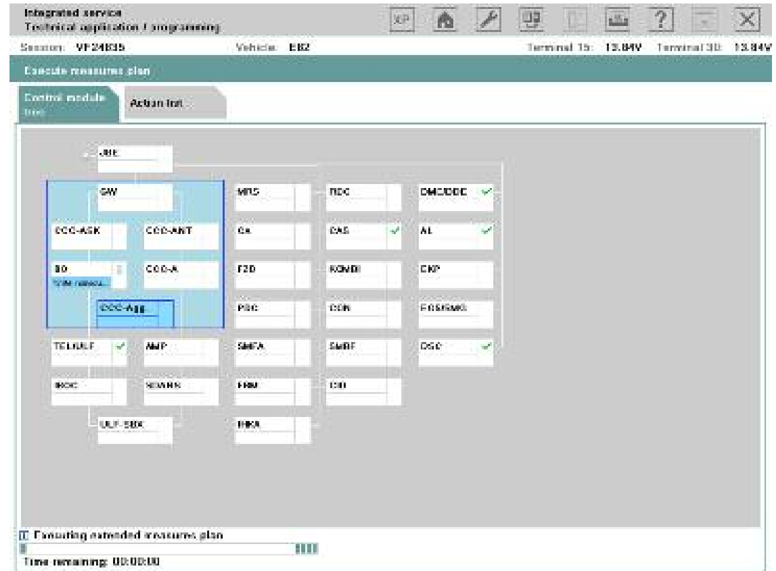
In the process of programming or coding a particular control unit, the system checks in each case whether the operation has succeeded before continuing with the programming of further control units. A particular version of ISTA/P distributes only one I-level. Programming of the vehicle as a whole (meaning all control units on the vehicle) is always performed to the latest I-level (target I-level).

The next step is to write the enabling codes to the relevant control units if required and modifying the vehicle order if conversions have been carried out. The programming of control units can also be performed simultaneously if they are on different bus systems, e.g. MOST and CAN.

The progress of the programming process is indicated by a progress bar.



Carrying out programming



View after completion of programming

If programming/coding/initialization has been completed successfully, there is a green tick by every control unit on which an action has been performed.

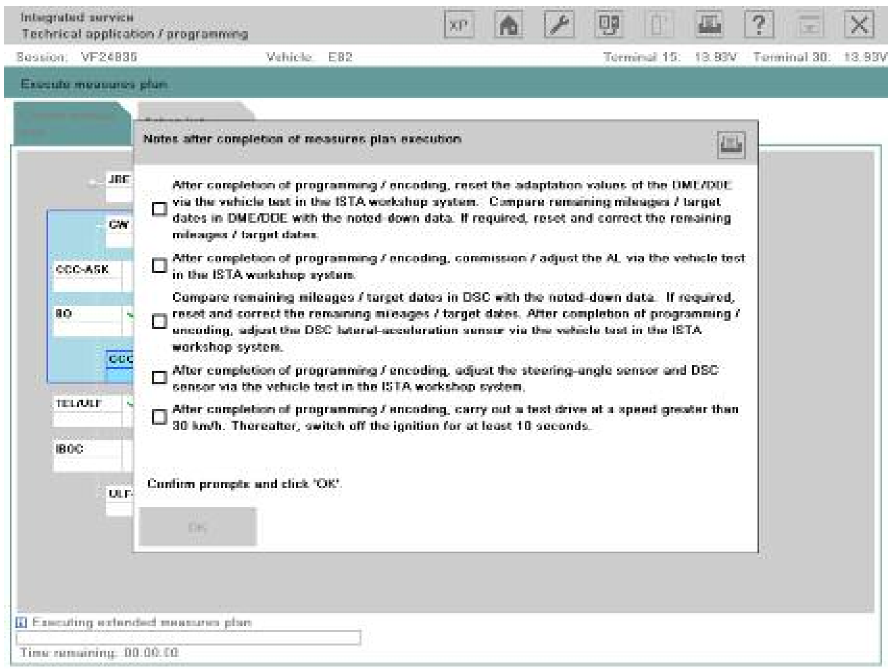
If an action has failed or not been completed, the control unit concerned is marked with a red X.

By clicking the control unit concerned, you can obtain information as to why programming failed.

Completing Programming Session

The last stage of the programming process is importing the customization, CBS and CKM data. The data is written back to the control units and checked. Afterwards, the automated initialization sequences are performed where required (electric windows/slide/tilt sunroof).

The automatic programming process is them complete. The initialization sequences that require user interaction are then carried out.



Notes on follow-up

After completion of the initialization sequences, ISTA/P establishes from the measures plan what service functions are required, e.g. setting steering angle. They are shown to the user. They have to be carried out as part of the diagnosis after programming. That is carried out by way of the vehicle test on the ISTA workshop system and afterwards all fault memories must be cleared.

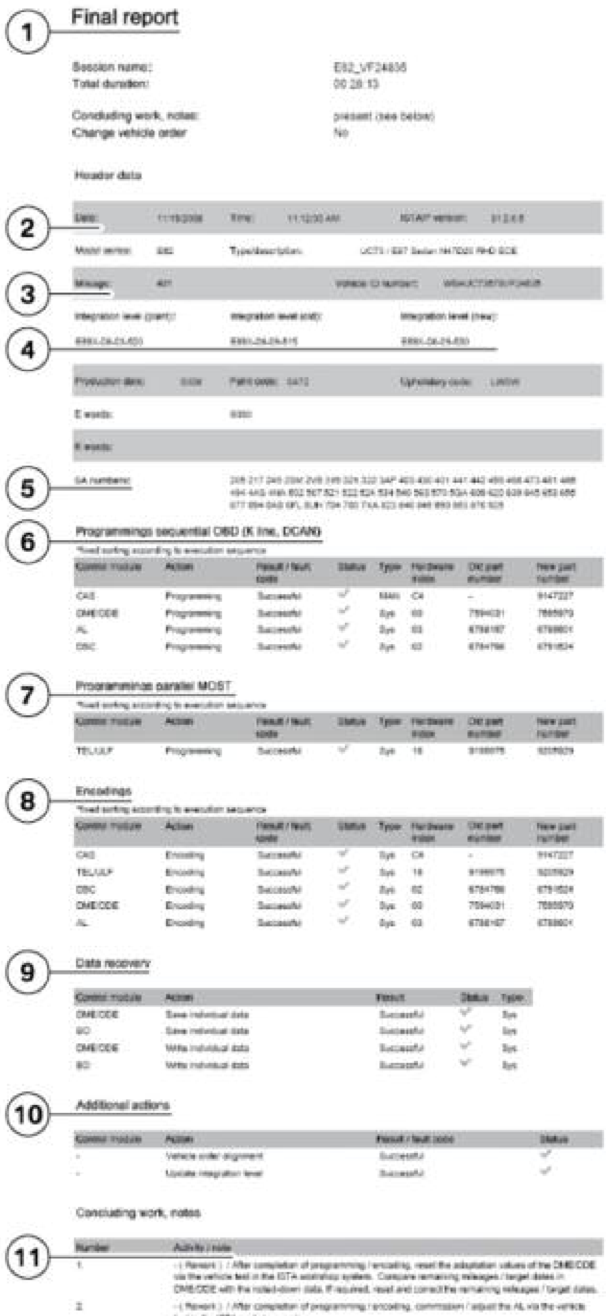
Finally, the actual status is checked once again and the final report produced. ISTA/P provides the user with the final report.

The user can print out the final report or else it is stored for a certain period on the ISIS.

The entire programming log is sent to BMW AG as part of the FASTA data. This allows BMW to retrace how the vehicle programming was carried out from the user actions, either for accounting purposes or if there is a subsequent fault.

Furthermore, that data is automatically analysed so that software errors can be detected at an early stage and suitable measures initiated. As a result, BMW is able to continuously monitor and improve software quality.

Final Report


Final report

Session name:
Total duration:
Concluding work, notes:
Change vehicle order

Header data

Programmings sequential OBD (K line, DCAN)

Programmings parallel MOST

Encodings

Data recovery

Additional actions

Concluding work, notes

Index	Explanation
1	Final report
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3	Vehicle data: mileage and VIN number
4	I-levels: factory, last, current
5	SA numbers
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